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RISING EXPORTS.

It is gratifying to note from the official returns for March that electrical exports continue to increase in value as the months go by. Our recent comment showed that the tide had been rising steadily for some time, so that it may be inferred that we see the exhibition of a tendency rather than watch a mere spurt. During March the exports of heavy electrical machinery amounted to $751,785, as compared with $639,338 in March, 1911, while the exports of miscellaneous electrical apparatus and instruments rose to $1,081,895, as compared with $915,601. It will be admitted that these are substantial gains, to see the maintenance of which will afford much pleasure to all of us, the advance in one group being 10 per cent and in the other 20 per cent. The most encouraging feature is that these gains were well distributed, so that hardly any one customer could be credited with "hitting up" his demands suddenly, only to relapse in the following month. It is to be remembered that we now know quite well the markets to which these goods go, but in most instances it may be assumed that the markets themselves are not at all intimately known.. Yet there are to-day very few, if any, new markets to open, and the great secret of swelling success will lie in the sedulous cultivation of the present areas of consumption where our goods are liked and where appetite grows by what it feeds upon.

SAFE CONSTRUCTION IN ENERGY-TRANSMISSION SYSTEM.

The new plant of the Shawinigan Water & Power Company described in this issue is conspicuous for the care that has been taken to insure continuity in service and freedom from some of the ordinary sources of failure. It is notably large, being designed for a final output of 100,000 hp, and the transmission is at 100,000 volts. This represents advanced practice, but in itself is not now at all the subject for wonder that it would have been a few years ago. The plant in general is a fine example of first-class modern practice, but it has features with respect to safety precautions which render it distinguished even among the best plants of recent construction. If there is any one thing important in energy transmission, it is to secure continuous service. This is indeed always and everywhere desirable, but in the case of a plant distant 75 or 100 miles from the point of use of the energy it is imperative that nothing should be left undone which can make certain the regular operation of the system every hour in the year. Experience in most large generating plants, whether driven by steam or by water, shows that it is the unexpected which happens. One may make a station apparently fireproof and foolproof and yet it may be shut down from some cause which *a priori* would be considered a rank impossibility. The

weakest link in the chain between the generator terminals and the outgoing mains is not always a conspicuous one and has many a time been found in connections back of the putative safety devices.

In the Shawinigan plant here considered unusual pains have been taken to avoid the chances of trouble that come from over-complication and an obsession of compactness. In the first place the station is, as far as a station can be, fireproof in construction, and particular care has been taken to keep the large units and their connections well separated from each other and so isolated that even in case of accident the station can be kept running under almost any possible circumstances. Another feature of the plant which is particularly striking is the fact that the protective devices on the low-tension side of the system are very close to the generators, actually on the generator floor, and with such short connections to the terminals as to afford almost no chance for accidents. One of the commonest weak spots in the ordinary station is between the carefully segregated switchboard apparatus and the generators. The closer the first protective device lies to its generator the safer will be the operation of the system. Again, the Shawinigan switchboard is, for a large station, unusually simple. The idea which has been carried out with the new station is that each generator unit with its transformers and connections constitutes a single operative unit, feeding energy through its own line to Montreal, except in so far as it is convenient to work it in parallel with its mate. At the Montreal terminal station the same independence is secured, and it is interesting to note that when this new Shawinigan station is paralleled with the old one it is done in Montreal through a loop circuit 170 miles long without the slightest difficulty. A 170-mile circuit makes an admirable electro-dynamic buffer, and trouble is far less likely under this arrangement than it would be under the more common device of insisting on running everything in parallel at the near end of the line, where the maximum possible mischief may be done in case of a short-circuit at any point.

Passing from the electrical precautions, one notes with particular interest the complete electrical heating system established at the gate house in order to check the accumulation of ice on the racks and the freezing up of the gate mechanism which has many times been experienced in power plants in a northern climate. The winter in Shawinigan Falls is not exactly sub-tropical at any time and is pretty regularly characterized in January and February by one or more periods of extraordinary cold lasting over some days, during which the thermometer often fails to rise anywhere near to the zero point. These are the times that try the souls of the station operators. In the Shawinigan gate house electric heaters of 300-kw input are provided for heating an air blast having an output of about 60,000 cu. ft. per minute, which is turned to the danger spots about the gate house, particularly against the tops of the racks and the steel work at the sides of the gates. The result has been to check ice formation inside the building and to stop the very exasperating tendency of the ice to stick upon the rack. The thorough warming of the upper part of the rack seems to lead enough heat downward along the rack bars to discourage the adherence of the ice, so that, although the present winter has been a severe one, there has been no difficulty in operating the head gates or from clogging of the racks. The transmission system is admirably designed along somewhat familiar lines. Both circuits are carried on the same line of towers, but the two circuits are completely separated, one on each side of the tower, with the conductors in vertical alignment on the usual suspension insulators. Like many other Canadian lines, these are of stranded aluminum cable, except where hard-drawn copper is used in a few long stretches. Lightning protection is carried out by two steel cables borne on the tower tops and the stations have special protection by electrolytic arresters. Altogether this plant has been planned most skilfully with reference to avoiding the too common risks of construction and securing that thorough independence between operating units which is so necessary to continuous and efficient service.

THE USE OF WATER-POWER.

The recent report of the commissioner of corporations to President Taft on water-power development in the United States, of which we publish an abstract this week, is full of interest to the engineer. To begin with, great work has been done within the past five or ten years in the utilization of hydraulic privileges. Nearly a million horse-power was added to the developments for railway and lighting service from 1902 to 1907, and from that date up to June 1 last the increase was even greater. At the present time approximately six million horse-power is the total of the hydraulic developments for the country, of which practically one-half is in large commercial developments for the distribution of electrical energy. As regards the extent of power undeveloped yet available, there is great difference of opinion and the tendency always is to overestimate the amount. Every engineer is familiar with the claims made for water privileges by their promoters and the astonishing way in which these shrink to an inconsequential reality. To form a really correct idea of the total water-power of the country would require a prodigious amount of investigation, involving the economic possibilities which determine the desirable development in each particular case, but in a general way a rough estimate can be made which is at least serviceable in gaining an idea of the remaining opportunities. Even this estimate is encouragingly, not to say astonishingly, large.

It is probably safe to say that the as yet unutilized privileges add up to something like twenty-five million horse-power at a moderate estimate of the flow and to possibly twice this figure as the maximum feasible development. These figures are based on the report before us. They should perhaps be discounted somewhat by the doubt which exists concerning the availability of many of the powers, particularly with respect to the chances of utilizing the whole fall theoretically available. Experience shows that in very many instances no considerable portion of the total fall in a given stream can actually be employed for useful purposes. Many things interfere—the danger of backwater from one plant to another, the fact that many of

the falls are too low to permit of thoroughly economical development, and the great variability of some of the streams, affecting differently various sites along the same river according to the possibilities of storage which are available. On the face of the figures the existing development of some six million horse-power is a little less than one-quarter of the whole taken at its conservative rating. It is probably nearer one-third of the power which can be developed with reasonable ease and with suitable prospect of economic reward.

The last reliable data on the total amount of power utilized in the country by various prime movers, dating back to 1907, run up to about twenty-three million horse-power, of which nearly nineteen million was in steam engines. The importance of the present water-power situation is emphasized by the fact that the existing water-power developments run to nearly 30 per cent of this total, and that the complete demand for power at the present time, allowing a reasonable increase within the last five years, would nearly or quite reach the total figure found for the powers as yet unutilized. The maximum estimate of nearly fifty million horse-power for these implied developments many of which would be uncommercial and most of which would require very extensive auxiliary steam equipments to make them useful and profitable. We are, therefore, more nearly in sight of the end of our water-power than of our coal supply, so far as practical utilization goes. The water-powers of the country are very irregularly distributed in three general areas, defined by the Appalachians, the Rockies and the Coast Range. Sixty per cent of the remaining powers lie in the last two districts. The coast states New York, Pennsylvania and South Carolina contain more than half of the powers thus far employed.

The commissioner of corporations notes with some apparent apprehension the extent to which the ownership of the powers, used and unused, rests in a relatively small group. He distinguishes, however, and very properly, two forms of large ownership which have made themselves manifest. The first is the single ownership of all the powers in a given territory, the second is the ownership of powers here and there by a single financial body. Of the advantages of the former type of common interest we have often spoken. It is altogether advantageous to work under a common management, in physical connection, the water-powers over a large territory. It tends to improve the diversity factor, to increase the reliability of service and to extend the utilization of the hydraulic resources available. This kind of common ownership has been developed to a very notable degree in this country, with on the whole remarkably good results. The tendency is altogether for the public interest, provided the supply is under somewhat rigorous government control, such as is growing under various forms of legislation in many of the states.

The second form of single ownership, which does not imply any of the advantages of united physical operation, more nearly justifies the questioning attitude of the commissioner of corporations. To the user of the energy obtainable it makes no conceivable difference whether the water-power equipment is owned by one person or another, so long as his needs are supplied at a reasonable price, nor should it worry anybody to find a large group of scattered water-powers under unified financial control, so long as each member of that group is administered on a sound, conservative basis. Public regulation can be applied as effectively to one small plant as to a dozen operated as a network. The danger, however, is sufficiently obvious. If a single person or company owns a group of scattered plants, it may operate them, so far as the public is concerned, almost as if they were independent. In this case it is not of any particular interest who holds the stock. There is a chance, and a chance which experience has shown to be a large one, that the group will be administered with the stock market rather than the consumer in view, so that the organization's real object is to load the group with all the securities it can possibly carry by one device or another, and then, when local regulation is sought to be applied, the owners come forward with a wail about the heavy amounts of securities on which they have to pay interest, securities held by innocent purchasers, ostensibly perhaps widows and orphans, and which must not be forced to deteriorate through the desire of the community for cheap electrical service.

This is an old game worked successfully in many fields besides that of hydraulic enterprise. It is no worse in this connection than in any other and presents precisely the same problem. If present tendencies go on, local supervision is more than likely to squeeze water out of the stock and put everything upon a businesslike basis. The mere fact that 60 per cent of the developed power is under the control of, say, ten large interests is not a thing of itself in the least disturbing, particularly when one realizes that half of this amount is loosely held through minority ownership in the securities and representation on the board of directors. The ten interests referred to control partly or wholly less undeveloped power at present than they have in the form of active plants. No inconsiderable proportion of the undeveloped privileges are subject to federal control, which should be rigorously exercised in the interest of the community served. State control is fully competent to deal with both the undeveloped and developed powers within reach, and it is infinitely more efficient in insuring a supply of cheap electrical energy to the people than would be any determined attempt to check either the utilization of water-powers or an addition to the holdings of those who now are keenly interested in such investments. There is no evidence whatever to show that a man who has made a wise investment and who is now serving the community well will fail to repeat this program if he buys another water-power site. Every horse-power that runs seaward unutilized is a net economic loss. One cannot conserve a hydraulic privilege in the way that he can conserve a coal mine. To attempt it is merely to insure the continued waste of valuable power. It seems to us that the function of government should be directed to the conservation of public interests in developed powers, rather than to depriving the public of the gains which may come from utilization. Regulation should be such as to encourage rather than discourage water-power development on a sound financial and commercial basis.

SCHENECTADY MEETING OF THE A. I. E. E.

The two hundred and seventy-third meeting of the American Institute of Electrical Engineers will be held at Schenectady, N. Y., on May 17, under the auspices of the Schenectady Section. The program of papers for the morning session at 9 o'clock is as follows: *Compression Chamber Lightning Arresters and the Protection of Distribution Circuits*, by Messrs. E. E. F. Creighton and F. R. Shavor; *Multi-Recorder for Lightning Phenomena and Switching*, by Messrs. E. E. F. Creighton, H. E. Nichols and P. E. Hosegood; *Studies of Protection and Protective Apparatus for Electric Railways*, by Messrs. E. E. F. Creighton, F. R. Shavor and R. P. Clark; *Ozone: Its Properties and Its Commercial Production*, by Mr. M. W. Franklin; *Propagation of Impulses on a Transmission Line*, by Messrs. J. H. Cunningham and C. M. Davis; *Frequency*, by Mr. D. B. Rushmore; *Some Mechanical Considerations of Transmission Systems*, by Mr. T. A. Worcester; *Electrical Characteristics of Suspension Insulators*, by Mr. F. W. Peek, Jr. At the close of the morning session a buffet luncheon will be served at the Mohawk Golf Club. The afternoon will be given over to entertainments and demonstrations. Officials of the American Locomotive Works and the General Electric Company have extended an invitation to inspect the local plant of these two companies.

There will be an evening session at 8 o'clock, at which the following papers will be presented: *Some Impressions of the Electric Traction Situation in Europe*, by Mr. C. E. Eveleth; *Freight Train Tests on an Electric Interurban Railway*, by Mr. S. T. Dodd. Following the reading and discussion of these papers there will be an informal smoker and social gathering. The local arrangements are in charge of a special committee, of which Mr. George H. Hill is chairman. The Institute headquarters during the meeting will be at the Mohawk Golf Club.

THE PATENT HEARINGS.

The hearings at Washington before the sub-committee of the House committee on patents, in reference to Mr. Oldfield's bill (H. R. 23,417) have continued almost daily. On May 3 Mr. J. George Frederick, of New York City, a former editor of *Printer's Ink*, entered objections to the bill on the ground that it will take away from the patentee the right to fix the retail price of his patented product. He argued that price maintenance on retail products of all kinds is a good thing for both the tradesman and the consumer. He also stated that a patentee ought to have the right, as now enjoyed, to control the accessories for use with his patented article, because otherwise the article might not fulfil its function in the most efficient manner, nor operate in a normal fashion.

It appears to be quite widely believed that the bill, if made into law, would cut deeply into the great volume of patent law practice. There were no hearings on May 4. At the hearings on May 6 and 8, adjournment being taken over May 7, representatives of the Gem Cutlery Company and the Ingersoll Watch Company advanced the arguments which have already become very familiar, in favor of retaining the right to fix the resale price on patented articles. It appears, in the case of clocks, for example, that the patent or patents under which the article may be manufactured almost without exception relate to comparatively trivial details or to some isolated feature which cannot control the commercial supremacy of the article. But a patent on an article of this sort is very valuable to the manufacturer because it allows him to exercise absolute dominion over the selling price, although at the same time it may be utterly worthless in respect to giving him a monopoly of the clock business.

ELECTRICITY DIRECTLY FROM THE COAL MINE IN PENNSYLVANIA.

The plans of the Lehigh Navigation Electric Company, Philadelphia, Pa., which include the erecting of a generating station near the coal mines at Hauto, Carbon County, Pa., involve one of the most important steps toward the economic use of coal without transportation and the transmission of electrical energy on a large scale that have thus far been taken in the United States. Hauto, the site of the central generating station, is located about 10 miles west of Mauch Chunk and is at the mouth of a railroad tunnel leading from the main body of anthracite coal owned by the Lehigh Coal & Navigation Company at Lansford. From here the energy for heat, light and motor service will be distributed by means of high-voltage transmission lines, reaching out through all eastern Pennsylvania and New Jersey and covering a territory with 2,500,000 population. The company has at present a waste product of about 500,000 tons of coal a year. This consists of coal particles and dust which pass through 0.1-in. mesh screens. All this culm is entirely unmarketable and will be handled so as to be burned in the company's boilers. The location of the main generating plant at Hauto was also determined on because of an abundant water supply. An existing reservoir is being increased to a storage capacity of 1,000,000,000 gal. and an area of about 400 acres by the construction of a higher dam. The water supply needs of the ultimate plant will be some 300,000,000 gal. a day, most of which will be carried back into the reservoirs after condensation. To run the plant up to the contemplated maximum installation of 100,000 kw, it is estimated that 1,000,000 tons of coal a year will be needed, a quantity of anthracite which would require 20,000 of the largest cars to transport to market.

It is planned to supply energy to the slate and cement industries in Lehigh and Northampton Counties, all of which are in a territory from 20 miles to 40 miles distant from the Hauto plant. Substations will probably be established at once at Coplay and Pen Argyl for stepping down and distributing the energy to users. Within a radius of 75 miles from the main station there are some twenty large cement mills. The transmission lines will be strung largely along the Lehigh Navigation Canal and on the right of way of the Lehigh & New England Railroad, which the company controls.

With the assistance of these companies a complete motor-service census of the industries has been taken, and within the district which will be reached by the distribution system of the first section of the Hauto plant over 100,000 hp is being used now. The Lehigh Navigation Electric Company has made up a schedule of prices, running from 8 mills up to some 2.5 cents per kw-hr. according to the amount of power contracted for and the steady continuance of consumption. At these rates the company will deliver its energy materially under the cost at which the industries are able to produce steam-power.

Under the laws of Pennsylvania the right of an electric supply company operating with steam to distribute energy is confined to a single township. Accordingly charters have been obtained in Lehigh, Schuylkill, Carbon, Northampton, Bucks and Montgomery Counties for about sixty electric companies. The first electric companies organized for each township are in Lehigh County and consist of the Hazard Electric Company for Hanover, the Oakdale Electric Company for Salisbury, the South Whitehall Electric Company for South Whitehall, the Equitable Electric Company for Whitehall, the North Whitehall Electric Company for North Whitehall, the Diamond Electric Company for Washington, the Upper Macungie Electric Company for Upper Macungie, and the Upper Millford Electric Company for Upper Millford. All subsidiary companies will be consolidated under the Lehigh Navigation Electric Company.

According to present plans the first installation at the Hauto plant will be in operation before the end of the year. The company is planning for an initial expenditure of $3,000,000 and has already placed an order for three 10,000-kva, 11,000-volt, three-phase, 25-cycle General Electric horizontal turbo-generating units complete, with two 300-kw turbo-exciter sets and one 300-kw motor-generator exciter set. The equipment of the plant will be gradually increased, the expectation being to supply energy to Allentown and Easton,, Pa.; to Trenton, N. J., and finally to Philadelphia, which is within 80 miles of the Hauto plant. The president of the company is Mr. W. A. Lathrop. Mr. Lewis B. Stillwell, New York, has acted as consulting engineer since the inception of the undertaking in 1908.

THE ELECTRIC VEHICLE AT BOSTON.

A meeting of the New England Section of the Electric Vehicle Association of America was held at the Edison Building, Boston, on April 30, with Mr. E. S. Mansfield in the chair. The speaker of the evening was Mr. W. P. Kennedy, consulting engineer, New York City, who discussed the problem of "Stimulating Business Activity in the Electric Vehicle Field." Mr. Kennedy emphasized the great necessity of exploiting electric vehicles in a scientific manner and advocated engineering salesmanship in place of the haphazard work which in many quarters is holding back the natural growth of the industry.

At the regular weekly meeting of the Electric Vehicle Club of Boston on May 1 Mr. Frank J. Stone suggested calling the attention of architects to the possibilities of roof garages for electric pleasure cars, in the preparation of plans for new department stores. Mr. W. H. Atkins emphasized the advantages of hiring special policemen to look out for the electric machines of feminine visitors to the shopping district, and intimated the willingness of the Boston Edison company to support a movement of this kind. Continuing the discussion of parking spaces, President Day Baker called attention to the plan followed on Broad Street, Philadelphia, a thoroughfare 70 ft. wide, where a double row of automobiles is allowed to park. It was urged that some consideration be given to the parking problem in connection with any new cross-town avenues to be constructed in Boston.

It was announced that about twenty electric-vehicle dealers had made arrangements to take exhibit space in the Boston 1912 Electric Show, to be held in October. Mr. E. S. Mansfield urged every dealer in this industry to be represented by at least one vehicle. Every effort is being made to establish at this exhibition the largest collection of electric vehicles ever shown under one roof. Mr. Mansfield announced that the Boston Edison company has just voted a larger appropriation than that made in 1911 to carry on the motor-vehicle research work of the Massachusetts Institute of Technology during 1912. Great applause followed the announcement, the value of the research work which is being carried out by the electrical engineering department being widely appreciated. The committee on suggestions was asked to consider the advisability of preparing advertising matter relating to the 1912 show for use in correspondence. It was stated that an electric-vehicle directory would also be a desirable feature of the show, covering the names and addresses of dealers, charging stations, garages and other information of the handbook type. It was further suggested that typical central-station load curves be prepared on a large scale for display at the show, to educate the visitor regarding the benefits of off-peak service and charging. Mr. W. P. Kennedy stated that the National Association of Automobile Manufacturers is planning to hold a convention of salesmen during 1912, at which time scientific methods will be considered.

CHICAGO SECTION, E. V. A.

A Chicago Section of the Electric Vehicle Association of America was formed on May 7 at a dinner given by the Commonwealth Edison Company to about 100 gentlemen interested in the industry. Mr. L. A. Ferguson presided. Mr. W. H. Blood, Jr., president of the Electric Vehicle Association of America came from Boston to explain the objects and aims of the association. A constitution and by-laws were adopted. The following officers were elected: Chairman, George H. Jones; vice-chairman, G. H. Atkin; secretary, J. W. McDowell; other members of the executive committee, Messrs. C. A. Murphy and L. E. Burr. A feature of the occasion was the announcement by Mr. Ferguson for the Commonwealth Edison Company that rates for electricity used in charging automobile batteries have just been reduced on an off-peak schedule of about 20 per cent, the new rate applying more particularly to the larger garage. Much interest and enthusiasm were manifested in the electric-vehicle campaign.

PATENT RIGHTS AND PUBLIC POLICIES.

Mr. Charles Frederick Adams, of Brooklyn, N. Y., formerly a practising lawyer in New York and now a lecturer of some note, addressed the Electric Club of Chicago on May 2 on the subject "Patent Rights and Public Policies." With much earnestness the speaker dwelt on the wide question of social progress, considering the patent situation as an illustrative incident. His plea in general was for recognition of the rights of the whole community, giving justice to the individual but subordinating his interests to those of the public at large. He pointed out that the power given by the Constitution to Congress in relation to the granting of patents for inventions is in the nature of a special legal right, to the exclusion of what would otherwise be a natural right of the community. Inventions are often the result of good fortune to a considerable extent, although, of course, earnest individual work and enthusiasm are not to be overlooked. The potentialities of invention are open to all, and the community should have care not to go too far in safeguarding the rights of the inventor.

With the growth of modern industrialism the original design of the government's policy toward inventors has been obscured largely, and often the existing patent system fails to protect the actual inventor. Speaking of the recent Dick decision, Mr. Adams commented on the fact that the judges gave opinion and inference in addition to expounding the law. Ordinarily any conscious effort of courts to usurp legislative functions should be rebuked. It has been said that the result in the Dick case was not so much a matter of patent law as of the general right of contract. One can make any fantastic condition he pleases, it is declared, as to the use another person may make of the first person's private property. Congress might retort to this argument by refraining from its affirmative action in giving exclusive monopoly for invention unless the grant is accepted subject to certain limitations protecting the community from the unethical use of the monopoly.

The speaker suggested that perhaps some form of remuneration could be made to the inventor in the shape of a royalty for the actual use of his invention. It is a hateful thing, he said, to take out patents for the purpose of not using them. Persons should be rewarded to the extent to which they do things. All persons who are not mentally or physically incompetent should be active in service. As for the public servants, they should be selected for loyalty and honesty rather than for mere cleverness. Mr. Adams spoke very earnestly, and in conclusion said that no man is attending properly to his private business unless he is doing his full share of public business.

WATER-POWER DEVELOPMENT IN THE UNITED STATES.

The report of the Commissioner of Corporations, Mr. Herbert Knox Smith, on water-power development in the United States was transmitted to President Taft under date of March 14, as already noted in our columns last week. This report deals with developed power, the ownership or control of such power and the fundamental principles of economics involved in its development and use. Particular attention was given to commercial power, generated for sale, rather than power produced for private uses, as in manufacturing. A summary of the important facts brought out by the investigation is reproduced below, in the form of conclusions.

1. A rapid development of water-power in recent years.
2. A rough estimate of the potential water-power of the country, together with the popular exaggeration of such power.
3. A marked local concentration of water-power.
4. An increasing concentration of the ownership and control of developed water-power of several localities in a few hands.
5. A substantial interrelationship among leading water-power interests.
6. A significant and increasing affiliation between water-power companies and street-railway and electric-lighting companies.
7. The importance of the prompt adoption of a definite public policy with respect to water-power development.

The recent development of water-power has been profoundly influenced by the rapid advance in the art of long-distance high-power transmission of electrical energy. The water-power development for railway and lighting service increased from 487,000 hp in 1902 to 1,441,000 hp in 1907, or nearly 200 per cent, which compares with 11 per cent increase in the development of water-power among the manufacturing industries from 1902 to 1905. This emphasizes the large part which water-powers play in public-service enterprises.

The most comprehensive estimates of water-power, developed and undeveloped, yet prepared are those compiled by the United States Geological Survey for the National Conservation Commission in 1908, but those estimates have been revised in the present report to a more conservative basis. The Geological Survey did not include any power for Pennsylvania because data were not then available, and it greatly overestimated the minimum available power at Niagara Falls. Under a treaty between the United States and Great Britain, only about 25 per cent of the Niagara theoretical power can be developed; of this amount only five-fourteenths belongs to the United States, because its share is diminished by the flow diverted from Lake Michigan to the Chicago Drainage Canal. This leaves a minimum of 518,000 hp developable on the American side of the Falls.

The Geological Survey figures are also questioned in the report on the ground that the assumed average turbine efficiency of 90 per cent should be reduced at least to 75 per cent, and again because the Geological Survey assumed that fully 90 per cent of the total fall can be developed. After making allowances for all factors but the last one, the report gives for the potential water-power of the country 26,736,000 hp minimum and 51,398,000 hp maximum, qualifying these figures with the statement that probably there is still some exaggeration. These totals include no allowances for storage, on which point there has been a great divergence among different estimates, tending to discredit the reliability of all figures covering this particular feature.

TOTAL POWER DEMAND.

At the latest date complete statistics were available, 1905-1907, the total installed prime-movers had a combined power of approximately 23,000,000 hp, of which 82 per cent was generated from steam, 15 per cent from water and about 3 per cent from internal-combustion engines. The proportion of water-power has probably increased since 1907, as would be indicated by the very large increase noted above, from 1902 to 1907, in the water-power used in railway and lighting service.

DEVELOPED POWER.

The statistics of developed water-power prepared in 1908 for the National Conservation Commission revealed totals as follows:

	Hp.
Installations over 1000 hp	3,396,103
Installations under 1000 hp	1,960,577
Total	5,356,680

The statistics collected by the Bureau of Corporations for the present report are applicable as of about June 1, 1911, and include only developments of 1000 hp or over, unless a concern having less than 1000 hp developed also owns enough more undeveloped to equal or exceed the above figure. The bureau has distinguished between two kinds of water-power, one being termed "commercial" power, which includes power for sale or distributed by public service companies, and the other termed "manufacturing," which is developed and consumed in private industries. The estimates made by the bureau are as follows:

	Hp.
Commercial development (over 1000 hp)	2,961,549
Manufacturing development (over 1000 hp)	1,054,578
Total	4,016,127
Installations less than 1000 hp (approximate)	2,000,000
Grand total	6,016,127

On the general distribution of the potential water-power of the country the report says: "The water-power centers of the country are the Pacific Coast and Intermountain States, the New England States and New York, the Great Lakes region and the states entered by the southern Appalachian range. Approximately 43 per cent of the total estimated minimum power of the country is found in California, Oregon and Washington. Adding to this the power in Montana, Wyoming and Idaho gives 60 per cent of the total minimum power in these six states."

There is a similar geographical concentration of developed water-power, as shown by the following comparison relating to purely commercial power:

	Per Cent of Total.
California	14
New York	13
Washington	10
Pennsylvania	6
South Carolina	5
Total	48

This reveals nearly 50 per cent of the developed commercial power as situated in five states. The concentration, in a geographical sense, of manufacturing power is even more marked, as shown below.

	Per Cent of Total.
New York	30
New England States	36
Minnesota and Wisconsin	17
South Carolina	5
Total	88

The report discusses in a brief way the factors which affect the power demand. Production and consumption of power are simultaneous and no storage on a large scale is

feasible, so that demand factors are exceedingly important to consider. There are also important variations in supply, or stream flow, which further complicate the general problem of economical development. The diversity of demand in different forms of power use or consumption and the diversity among the demands of different localities constitute an important advantage, which can be realized by means of electrical transmission and distribution over wide areas, thus reaching diversified markets. Another important and useful type of diversity is the dissimilarity in the run-offs of different watersheds and in different portions of the same general watershed. This makes it advantageous, from the standpoint of diminished fluctuations in total power supply, to develop different sites on neighboring streams or different sites on the same stream. Thus the developments of water-power sites and the electrical transmission and distribution of energy are mutually stimulative in a great degree. Of course, the advantages of pondage and, where feasible, extensive storage are very important in an economic sense.

CONCENTRATION OF OWNERSHIP.

It is pointed out that local concentration of ownership carries with it important economic advantages, but such concentration also demands rigid federal or state supervision to protect the public from abuse of monopolistic control. The tendency toward such concentration is marked and takes two forms, one of single ownership of all the power in a given locality and another of ownership of scattered power by a single interest. The bureau's investigation shows that in no considerable area is the present water-power supply equal to the total power demand, and this tends again to result in monopolistic ownership or control because of its immediate advantages.

Another circumstance, the report states, which tends to increase the concentration of ownership is the frequent custom among manufacturers of accepting the securities of hydroelectric companies in whole or part payment for equipment or machinery. These manufacturers, comparatively few in number and doing an extensive business, thus have been led into the hydroelectric field. A number of financial houses have made a specialty in this field, and they constitute another class of controlling interests, which is supplemented by the individual holdings of officers or directors of equipment, engineering and financial houses.

CONTROL IN SPECIFIC LOCALITIES.

Commissioner Smith cites the instances of local ownership or control which are here condensed in tabular form.

WATER-POWER CONTROL ACCORDING TO LOCALITIES.

Location.	Number of Companies.	Total Developed Hp Owned or Controlled.	Per Cent of Total Developed Power.
California	6	374,683	86
Washington	2	210,000	70
Montana	2	134,260	96
Colorado	1	47,000	67
South Carolina	1	101,000	75
North Carolina	2	69,000	..
Georgia	5	109,050	86
Michigan (lower peninsula)	1	51,800	73
Niagara Falls	2	262,000	100

The table applies to power exclusively in the United States. In Wisconsin the concentration of ownership has not progressed so far as elsewhere, but there is a marked tendency in that direction. More than half the power in Wisconsin is owned by manufacturing concerns, principally in lumber, pulp and paper industries.

CONCENTRATION OF OWNERSHIP.

The local control of water-powers in specific localities is overshadowed by the concentration of general ownership by large interests. Out of a total of 2,961,549 hp of developed commercial power, the report states that over 1,800,000 hp, or 61 per cent, is controlled to a greater or less extent by ten groups of interests. These groups are briefly mentioned in the accompanying table taken from the report. Each of these groups has 50,000 hp or more developed or under construction.

COMMERCIAL WATER-POWER CONTROLLED BY OR UNDER THE INFLUENCE OF COMPANIES OR GROUPS OF INTERESTS EACH HAVING 50,000 HP OR MORE ACTUALLY DEVELOPED OR UNDER CONSTRUCTION.

Companies or Groups of Interests.	Developed and Under Construction, Hp.	Undeveloped, Hp.	Total Hp.
General Electric interests:			
A. Power completely controlled	82,860	5,500	88,360
B. Power coming under General Electric influence where there occurs both minority ownership of securities and common directors	419,060	522,600	941,660
C. Power coming under the sphere of General Electric influence through common directorships only	437,195	113,500	550,695
Total General Electric group	935,115	641,600	1,580,715
Stone & Webster interests	278,067	372,350	650,417
Hydraulic Power Company of Niagara Falls	144,000	20,000	164,000
Pacific Gas & Electric Company	118,343	100,000	218,343
Clark-Foote-Hodenpyl-Walbridge interests	104,300	158,000	262,300
Southern Power Company	101,680	104,000	205,680
S. Morgan Smith interests	76,550	96,000	172,550
Brady interests	70,600	16,200	86,800
United Missouri River Power Company	65,000	.....	65,000
Telluride Power Company	56,350	21,300	77,650
Grand total	1,821,305	1,449,450	3,270,755

The totals in this table exclude all duplications, which amount to 137,200 hp developed and 80,000 hp undeveloped. In addition there are seven companies each having between 25,000 and 50,000 hp, and four of these have more than 40,000 hp each. Thus more than 2,000,000 hp of commercial power is under the control or strong influence of seventeen groups of interests.

The report analyzes each of these groups in detail, showing six companies in the "A" group of General Electric companies, eight in the "B" group and ten in the "C" group. There are also eight companies in the Stone & Webster group. Other interests mentioned are those under the control of H. M. Byllesby & Company, the Gould interests, the Westinghouse interests and the International Paper Company.

The relation of these interests and their holdings to public-service corporations is discussed in the report at some length, and it is stated that in the country as a whole water-power companies or concerns affiliated with them own or control and operate street railways in no less than 111 cities and towns, electric-lighting plants in 669 cities and towns and gas plants in 113 cities and towns. The interrelationship of these interests, through stock ownership, interlocking directorates and common banking connections is also discussed and specific examples are cited.

Proper methods of regulation and development are taken up in the closing section of the summary, where it is pointed out that the fundamental problems which arise in formulating a wise public policy are as follows:

1. The best development of the source.
2. The protection of the consumer.
3. The reservation, for the benefit of the whole public, of its proper share in the advantages inherent in the natural resource itself.

Water-power development is highly desirable for the purpose of conserving fuel and should be encouraged in all legitimate ways. The power now utilized in industrial and public-utility enterprises probably exceeds 30,000,000 hp, of which 6,000,000 is developed by water. Conservatively this saves at least 33,000,000 tons of coal per annum, but several millions of additional horse-power could be profitably developed from water. The report sets forth the conclusion that it is not feasible or advisable to regulate the price of

water-power by itself, but rather to control the site or the use of the site. Water-power differs essentially from many other natural resources in the respect that it is not exhausted by use. Whatever method of control is finally adopted, it is imperative to work out a definite federal and state policy, in order to encourage the development and use of all commercially available water-power and forestall the possibility of public water-powers passing into absolute private control.

PORTLAND MEETING A. I. E. E.

The Pacific Coast meeting of the American Institute of Electrical Engineers, held in Portland, Ore., on April 16 to 20, proved highly successful, the attendance reaching 197 members and guests. A feature of more than ordinary interest which had not been noted on the preliminary printed program was the presentation by Mr. O. B. Coldwell, as chairman of the Portland Section of the Institute, of a silver loving cup to President Gano Dunn. Entertainment features provided included a "Seeing Portland" tour for the visiting ladies and a visit by both delegates and ladies to Willamette Falls on the steamer *Undine*. On the return trip the vessel ran aground. The passengers had to be transferred to another boat and were about four hours late in reaching their hotel. An all-day excursion by special train was made to the River Mill and Estacada stations of the Portland Railway, Light & Power Company. A truck of a car on this train was derailed, thereby causing a delay of about two hours on the return.

At 6:30 on Tuesday evening in the main dining-room of the Multnomah Hotel a delightful informal dinner was served, at which there was an attendance of about 200 members, visitors and ladies. The speakers of the evening were President Gano Dunn, Messrs. S. G. McMeen, W. W. Briggs, A. H. Babcock, R. W. Pope, A. V. Joslin and J. E. McDonald, and Mrs. A. H. Babcock. Subjects of lighter vein were indulged in, with some concentrated effort to determine why President Dunn insists upon remaining a bachelor. The notable event of the evening was the speech of Mrs. Babcock, she being, as far as available records show, the first lady to speak before an assemblage of the American Institute of Electrical Engineers. Those present at the dinner enjoyed the reminiscences of Honorary Secretary Pope, which he outlined from the beginning of his connection with the telegraph, through the developments of the electrical art up to the present time.

Abstracts of the papers presented at the meeting are given below.

ARC VERSUS TUNGSTEN STREET LIGHTING IN SMALL TOWNS.

In a paper by Mr. C. E. Stephens the general requirements for proper street lighting were outlined as having a bearing upon the selection of lighting units. The author stated that in small towns the streets that require first-class illumination are public squares, the principal business streets, streets leading to railway stations, where vehicles and pedestrians are numerous, and certain sections of streets where crime abounds. The streets requiring second-class illumination are those where nocturnal travel is light or moderate. The streets requiring third-class illumination are those in the outlying portions of the town, perhaps not yet built up but still within the city limits. Assuming that all small towns have a certain amount of first-class, second-class and third-class lighting, the author claimed that it would be necessary to use both arc and incandescent units. If the number of arc lamps is large enough to admit of installing one complete circuit, use can be made of either metallic filament or flame carbon lamps. If, however, only a small number of arc lamps are required, it may be necessary to use the alternating-current flame carbon lamps and operate them in series with tungsten lamps in the residence sections. For second-class and third-class lighting the tungsten lamp is better adapted than is the arc lamp. The author stated that it is possible to make enormous improvements in almost any system of street lighting by relocating the lamps, raising them higher from the street, removing useless and replacing crooked or decayed poles, and giving the lamps and reflectors sufficient attention to insure a pleasing appearance. The street-lighting unit, being the one piece of electrical apparatus that is constantly in the public eye, should be kept at all times in first-class condition. Street lamps are subject to most severe weather conditions, and dust and smoke within a very short time have a deteriorating effect on the appearance of lamps. A large proportion of industrial and manufacturing plants, stores, etc., have realized the advantages of keeping lamp globes and reflectors in good condition, and the results obtained have been highly satisfactory.

This paper was discussed by Messrs. Gano Dunn, G. R. Corley, G. S. Murphy, S. C. Lindsay, E. B. Miller, A. Y. Hall, G. H. Simpson, J. B. Fisken, A. Martin, L. D. Gilbert, O. B. Coldwell, L. B. Cramer and H. M. Friendly. Mr. Lindsay particularly recommended the electrolier system for its pleasing effect, while Mr. Friendly objected to this system on the grounds that the numerous posts required occupy too much valuable space, especially on narrow sidewalks. He suggested the mounting of lamps on the side of buildings.

AIR-GAP FLUX DISTRIBUTION IN DIRECT-CURRENT MACHINES.

In a paper by Prof. Charles R. Moore were described tests relating to the distribution of flux around the air-gap of direct-current machines, especially under full-load conditions. Use was made of an exploring coil, similar in shape to one of the regular armature coils, mounted on the armature and connected to two slip-rings, through which connections were made to the oscillograph. The exploring coil was given a throw equal to the full pole pitch, so that the wave shape of time value of the emf in this coil represented the wave shape of space value of the magnetic flux around the air-gap. The author described methods which can be employed for predetermining the flux distribution from the design constants of the machine, and claimed that the flux distribution curves for any load on a machine can be predetermined with an accuracy approaching closely the experimental observations. He stated that the positions of the flux distribution curves are affected to only a limited extent by variation in the position of the brush, so long as the brush remains near the neutral point. The field-circuit mmf needed to overcome the armature mmf may be calculated without any special reference to the cross-magnetization or demagnetization, in the sense usually employed in standard textbooks.

IRRIGATION IN THE SPOKANE VALLEY.

Much information concerning the practice of irrigating land by water obtained from wells, as carried out in the Spokane Valley, was given in a paper by Mr. L. J. Corbett. The water is lifted from the wells by means of centrifugal pumps driven by alternating-current motors. The cost of operating the pumping equipment for the season of 1911 was about $6.50 per acre, including maintenance, but not interest and depreciation. The average cost of the equipment is about $51 per acre, which is completely covered by the increase in value of the irrigated land over that of land not irrigated. The water is required for irrigation from May 1 to Sept. 1, during which time a total of 14.4 in. of water is supplied. This paper was discussed by Messrs. B. I. Anderson, J. B. Fisken, W. A. Hillebrand, R. Howes, J. R. King and E. B. Mitler. Mr. Fisken stated that during the past eight or ten years he had known of several instances where land advanced from $2.50 per acre to $800 and more per acre.

The question was asked why it would not be a good

scheme to irrigate at night, employing a small stream of water for a greater length of time in order to improve the load-factor. To this query Mr. Corbett replied that the soil is of such nature (there being an underlying stratum of gravel) that too much seepage would take place, thereby causing the soil at the head of the ditch to get too much water and that at the end not enough. In some cases it may be wise to install some form of casing with proper outlets for distributing the water where the soil is particularly porous.

Mr. King remarked that in some instances a rate as low as 0.85 cent per kw-hr. had been charged for off-peak service in connection with large irrigation projects.

The Wednesday morning session was devoted to the application of the telephone, the first paper being by Mr. Gerald Deakin.

AUTOMATIC PRIVATE-BRANCH TELEPHONE EXCHANGE DEVELOPMENT IN SAN FRANCISCO.

Mr. Gerald Deakin presented a paper in which an attempt was made to show that the unattended sub-telephone office is by no means the limit of subdivision, and that subdivision has now been extended successfully to include two somewhat distinct types of private-branch exchanges, one type to meet the requirements of apartment houses and family hotels, and the other the more exacting requirements of all classes of commercialized organizations and business houses. The author stated that, while the automatic private exchange may be considered a success in the larger cities, the development of automatic apparatus in general has not yet reached the stage where it may be placed in localities which cannot afford ample skilled labor to supervise it.

The discussion was participated in by Messrs. S. G. McMeen, A. H. Griswold, A. H. Dyson, R. W. Pope and D. Fullerton. Mr. Griswold brought out the fact that the automatic system as described by Mr. Deakin would soon completely solve the intercommunicating problem. Mr. Dyson stated that this had been the most troublesome of present-day telephone problems. Mr. Dyson also expressed the belief that eventually the automatic telephone would entirely supersede the manual system except for toll service, thereby eliminating the five or six operators now necessary to establish connection between cities. Mr. Fullerton made the statement that one of the chief complaints against the manual system to-day is the length of time taken to call a party where it is necessary to be connected through a private exchange. The telephone company has no jurisdiction over private-exchange operators and therefore cannot correct the apparently unnecessary delays that are so frequently experienced. Mr. Pope came to the rescue of the telephone companies against complaints of slow service by saying that the public uses little judgment when calling up large commercial organizations where it is necessary to make connection through a private exchange. If the party calling would only state his business, the operator could immediately connect him to the proper person—the public must be educated in this respect before it can expect efficient service. Mr. Deakin stated that one of the greatest advantages of the automatic private-branch exchange is that an outside party, once connected to the trunk line, can call one local number after another in that exchange without having to disconnect.

DESIGN OF TELEPHONE POLES.

Mr. A. H. Griswold presented a very interesting paper on "Design of Telephone-Pole Lines for Conditions West of the Rocky Mountains," dealing with the trying conditions peculiar to the Western territory, one of the interesting features being the "silver thaw" encountered in the Pacific Northwest. This condition arises from the freezing of the heavy fogs, which sometimes causes a coat of ice 4 in. in diameter to form about the telephone lines, resulting frequently in complete destruction. In the southeastern section of California temperature ranges from zero to 130 deg. Fahr. have been known, giving rise to very severe conditions.

The discussion of the paper was participated in by Messrs. A. H. Dyson, D. Fullerton, F. Beagles, G. Deakin and A. H. Babcock. Mr. Fullerton described several methods of reinforcing decayed poles, one of which consists in placing a concrete band about the weakened part. Reference was also made to the "California splice," which is formed by lashing to the tops of short poles two pieces of timber about 4 in. by 6 in. by means of an angle iron, straps and bolts. This form of splice has come into quite general use, even by the transmission companies, where poles of great length are necessary. This splice is used only with square poles. The telephone and telegraph companies experienced much trouble in the marshes near Stockton, Cal., where the poles are set in peat bogs; the peat catches fire and the poles are burned off below the surface. An attempt was made to remedy this difficulty by putting a 0.5-in. band of concrete around the pole bases, but this caused such rapid decay that the evil therefrom was almost as great as that from the peat fires. Mr. Babcock suggested making an annular countersunk rim at the top of the concrete band and filling this with asphaltum paint to prevent decay. Mr. Beagles told a very peculiar experience on the telephone line between Truckee and Lake Tahoe, Cal., in which region the copper wires seem to be attacked by a gas which permeates the air and causes a green scale to form on the conductors, eventually destroying them. The gas cannot be detected by any ordinary methods and would furnish a theme for careful investigation.

AUTOMATIC CALL DISTRIBUTION IN TELEPHONE OFFICES.

Mr. Alfred H. Dyson presented a paper on "The Application of Automatic Selecting Devices to Telephone Multiple Switchboards," setting forth theoretically the results to be expected from substituting automatic call distributers in place of the usual answering jacks and cord circuits, in manually operated, common-battery, multiple switchboards. The author concluded that operating costs will be decreased in all cases by the use of the automatic call distributers, and that the first cost of equipment will be less in single-office exchanges of 6750 lines or more and in multi-office exchanges of 4300 lines or more. He also claims that changes from manual to automatic operation can be accomplished without disturbing the service in any way or impairing its efficiency.

Messrs. G. Deakin, D. Fullerton, H. Y. Hall and A. H. Griswold discussed the paper, but owing to the very limited time an extended discussion could not be gone into.

PARALLEL OPERATION OF ALTERNATING-CURRENT STATIONS.

A paper by Mr. J. W. Welsh contained a discussion of the parallel operation of alternating-current generators and alternating-current stations feeding energy into a common system. By means of vector diagrams the author undertook to show that when the cross-circuit interconnecting two alternating-current generators is made up of both the resistance and reactance, the adjustment of the field strength causes a transfer of load proportional to the resistance component of the cross-current, and adjustment of the governor on the prime movers causes a transfer of load proportional to the reactance component. He stated that wattless current is transferred by field adjustment in proportion to the reactance component of the cross-current and is transferred by governor adjustment in proportion to the resistance component. He concluded that it is possible to secure any desired sharing of the load and of the wattless current between two units operating in parallel by a proper proportioning of the voltage of each unit, either by field strength or prime mover governor adjustment. In deriving his unusual conclusions, the author made no attempt to take into consideration the effect of the inherent load characteristics upon the relative time-phase positions of the generator voltages.

Mr. Welsh's paper was discussed by Messrs. W. V. Lyon, H. Y. Hall, P. M. Downing and W. A. Hillebrand. Mr. Lyon, in a written discussion, disagreed with the author, saying that the examples as cited did not agree with practical conditions except where the power-factor of the system is unity. Mr. Lyon's contribution went considerably into detail, showing vectorially his difference of opinion. Mr. Hall took issue with the statement of the author that either by field or governor adjustment it is possible to distribute the loads between generators operating in parallel. Mr. Hall stated that this conclusion is true only in the case of direct-current machines, and that the division of load between alternating-current generators depends absolutely upon the machine characteristics and not upon the setting of the field rheostats—the actual division of the load depending upon the governor setting. Mr. Downing agreed with Mr. Hall as to governor setting being the proper way of adjusting the division of load between alternating-current generators. He also stated that the Pacific Gas & Electric Company, of San Francisco, is operating about twenty hydroelectric plants, ranging from 20,000 kw down, in parallel and that the division of load is controlled by means of governor adjustment and the wattless component taken care of entirely by means of synchronous condensers with voltage regulators located near the center of load. Mr. Hillebrand, of Corvallis, Ore., likewise expressed the opinion that in practical cases the field adjustment has very little to do with the division of load between alternators, though in an isolated case of two small alternating-current generators the load can be controlled to some extent by that means.

In closing the discussion of his paper the author said that his conclusions had been somewhat misunderstood, as he did not intend to convey the idea that if the engine governors were blocked a division of the load could be affected by adjusting the field rheostats, but that he had assumed that the governors would automatically admit sufficient steam or water to allow the generators to keep their emfs in time-phase, in which case the regulation of the field strength determines the division of the load.

THE LOSSES IN A HYDROELECTRIC SYSTEM.

Mr. J. D. Ross presented a paper in which was given an analysis of the losses and efficiencies in the system of the Seattle Municipal Light & Power plant, as determined by measurements and calculations. The calculations given were based on the average for the year 1911 and were expressed in percentage of the penstock input. The loss in the penstock itself was 2.31 per cent, in the waterwheels it was 37.81 per cent, in the generators 3.78, in the exciters 1.26, in generating-station lighting 0.33, in step-up transformers 2.14, in transmission lines 0.72, in step-down transformers 1.32, in the station lamps, motors, etc., 0.66., in the motor-generator and direct-current circuits 0.82, in 2400-volt feeder regulators 0.34, in 15,000-volt lines 0.18, in 15,000-volt transformers 1.47, in 2400-volt primary circuits 0.99, in 2400-volt distributing transformers 2.64, in cluster lighting transformers 0.35, in series street-lighting transformers 0.25, in secondary circuits of the commercial system 1.49, in cluster lighting secondaries 0.25. The street-lighting line loss was 0.44 per cent and the loss in customers' meters 0.48. The over-all efficiency of the plant throughout the year was 39.5 per cent.

The Seattle plant is a hydroelectric system delivering water to two 1500-kw Pelton units and two 500-kw turbine units, operating under a 600-ft. head through two pipes approximately 3.5 miles long. The energy is transmitted at 60,000 volts through two lines to Seattle, a distance of 38.7 miles, and is distributed at 15,000 volts and 2400 volts for use by approximately 20,000 customers and for the city street lighting.

The paper was discussed by Messrs. S. J. Lisberger, L. Harza, J. B. Fisken, H. Y. Hall, B. Howes and O. B. Coldwell. Mr. Lisberger claimed that such items as station lighting should not be included in the losses, but should rather be charged to operating expenses. Mr. Harza said that in almost every case waterwheels entirely too large for the generators are selected, the result being excessive losses at light loads.

PRACTICAL JOINT-POLE CONSTRUCTION.

The Los Angeles method of joint-pole construction, which has been successfully used for five years, was described in a paper by Mr. J. E. MacDonald. A working agreement was executed by nine companies operating in a given territory, the executive power being assigned to a committee acting without compensation. This committee is composed of one representative from each member company, all representatives having similar authority, regardless of the poles owned by the company represented. In the combination use of existing poles selection is made of the most satisfactory poles in the location where it is desired to make the combination, and the owner of the existing poles charges the combining parties a proportional interest in the poles at a rate fixed by the committee. New pole lines are constructed by one of the parties in such a manner as to be suitable for combination use, and this party then charges other parties a fixed rate for occupying the poles in case they wish to do so. The success of the combination method seems to be attributable to the absence of coercion, no company joining the combination unless in each instance it is found to be to its advantage to do so. During the past five years combinations have been made on 21,270 poles, and it is estimated that the number of poles eliminated exceeds 30,000. The length of the average pole in combination use has been found to be 43 ft.

Those who discussed the paper were Messrs. A. H. Griswold, O. B. Coldwell, S. J. Lisberger, P. M. Downing, J. B. Fisken and Gano Dunn. Mr. Griswold expressed the belief that the various pole users will be compelled to get together in the near future and adopt some general policy of joint-pole ownership, because if they do not public service commissions will adopt drastic and silly measures bearing on the subject. Mr. Coldwell remarked that the greatest obstacle in the path of the general adoption of a joint-pole policy by the operating companies is the adjustment of liability clauses. Mr. Lisberger said that the most serious objection to joint-pole use is due to the hazard resulting from high-voltage lines coming down on the low-voltage distributing systems. He cited an instance in Oakland, Cal., where the 11,000-volt lines of the Pacific Gas & Electric Company came down on the same company's low-voltage lines, completely clearing several poles of eight feeders, thereby causing a serious interruption of service. He believes that a proper solution of the impending difficulties resulting from so many pole lines is to place everything underground, and toward this end the cities should cooperate with the companies.

SELECTION OF A WATERWHEEL UNIT.

The features entering into the particular design of a waterwheel which will best meet the conditions under which it is to be operated were discussed in a paper by Mr. O. B. Coldwell. The author outlined the elementary hydraulic principles and briefly described the different available types of waterwheels. He stated that the choice and design of a particular type of runner to suit some given fixed condition can best be based on what is known as the specific speed of the runner, which is defined as the speed at which the runner will operate when delivering unity horse-power under unity head. A consideration of the factors entering into the design of waterwheel runners, and of tests which have been made on various designs, shows that the best efficiencies can be obtained when the specific speeds have values ranging between 40 and 50. Attention was called to a large number of the principles which cannot be overlooked when selection is made of a wheel.

The discussion was participated in by Messrs. L. Harza, P. M. Downing, V. W. Greisser, J. B. Fisken and J. D. Ross. Mr. Harza emphasized the necessity of co-operation between the purchaser and the manufacturer in order to select a design best suited for each particular case.

ALTERNATING-CURRENT SYSTEMS OF UNDERGROUND DISTRIBUTION.

Messrs. S. J. Lisberger and C. J. Wilson presented a paper giving the details relating to the constructive features and operating characteristics of the alternating-current system of underground distribution of the Pacific Gas & Electric Company. They stated that the design and operation of such a system, as compared with a direct-current system, presents no serious difficulties provided suitable sectionalizing devices are used on the high-voltage parts of the system. Safety to the workmen and continuity of service demand the use of more reliable apparatus on an alternating-current system than is required on a direct-current system. The experience of the above-mentioned company with a system the load on which aggregates 12,000 kw shows that such a system can be operated with good success.

Messrs. E. G. Allen, J. B. Fisken, W. J. Wakeman, S. B. Clark, J. W. Welsh and S. C. Lindsay joined briefly in the discussion of the paper, Mr Fisken expressing the desirability of low voltage as against high voltage for sign lamps.

UNDERGROUND DISTRIBUTING SYSTEMS.

The underground distributing systems of the Portland Railway, Light & Power Company were described in a paper by Mr. S. B. Clark. This company makes use of three classes of cables—high-tension, 600-volt and 120-240-volt. All of the high-tension cables operate at 11,000 volts, the 600-volt class includes railway feeders and tie lines, and the 120-240-volt cables are for the three-wire Edison system. The system as a whole contains a total of 113 miles of cable of different sizes, 50 miles of trunk duct, 51 miles of distributing duct and 6 miles of service duct. The paper contained a detailed description of the material required and method of making a splice in a concentric 1,000,000-circ. mil cable.

Unfortunately, the time was so limited that justice could not be done to the discussion of Mr. Clark's paper, though Messrs. J. B. Fisken, S. J. Lisberger, S. C. Lindsay, E. G. Allen and J. W. Welsh had a few words to say bearing on the subject.

ACCOUNTING MEETING OF THE EMPIRE STATE GAS & ELECTRIC ASSOCIATION.

A meeting of the Empire State Gas and Electric Association was held at the Country Club, Schenectady, N. Y., on April 26. It was devoted to the discussion of the subject of the uniform system of accounts used by the companies in accordance with the order of the Public Service Commissions of the First and Second Districts.

The meeting was called to order at 10:15 a. m. by Mr. C. G. M. Thomas, Long Island City, who referred to the purposes of the meeting as announced in the call. The idea of the accounting committee was to find out if there are any inconsistencies in the present classification and, if so, to get them in shape to be presented to the commission with constructive suggestions for modifications to eliminate them. Other questions which the committee wanted to have discussed were amortization and the clearing of fixed capital.

Mr. Thomas called upon the accounting committee for a specific statement of matters which it was desired to take up. Mr. E. W. Poole, of Syracuse, responded first for the committee. He outlined the work which had been done by the committee since the last annual meeting of the association. Meetings have been held to consider questions arising in reference to the uniform system.

Mr. W. C. Wishart, statistician of the New York Public Service Commission, Second District, was then called upon and explained the conditions under which modifications in the law would have to be made. According to the law, notice of alterations by the commission in the required method of keeping the accounts is to be given at least six months before they are to take effect. If changes were desired in the year beginning Jan. 1, 1913, they would have to be requested of the commission in sufficient time to permit consideration and action by July 1, 1912.

Mr. J. C. DeLong, of Syracuse, said that the question of any changes that might be desired should be considered by the companies without delay and information regarding them should be sent directly to the association. The subject was of sufficient importance to justify another meeting to consider the matter.

In response to the request of the chairman, several questions regarding the classification of accounts were raised. Mr. Herman Russell, of Rochester, said that the Rochester Railway & Light Company manufactures both water and coal gas and in order to ascertain the costs of both kinds it was necessary to separate the accounts. He suggested that the system make provision for such a separation.

A question was asked regarding the account to which expenses of a representative of the production department should be charged. Mr. Poole said he thought this expense should be charged to some production account. It should be charged to the same account as the salary.

Mr. E. C. Scobell, of Rochester, chairman of the accounting committee, in presenting further the details of the report of the committee, said that only one answer had been received in response to the circular of inquiry. He thought that the object of the trip of an official of a department should indicate the account to which the expense should be charged. An official of the company made a trip as a representative of the company and therefore his expenses were part of the general expenses. If his trip was made for a specific purpose, the cost could be charged to miscellaneous gas or electric expense. However, the object of the trip should govern the charge.

T. W. Summers, of Ithaca, said that he had not found any account which provided for repairs of an office building. It was stated that this item had been overlooked in the system of accounts.

Mr. J. A. Brucker, of Schenectady, thought that it might be well to have a general miscellaneous expense account in the various divisions of operating expenses. He referred to an instance of a building which was used for different departments and thought that the expense of heating, etc., should be apportioned among these departments.

Mr. H. M. Edwards, New York, said that he would rather see that expenditure treated as a general expense. Wherever a utility has a general relation to all departments he would rather treat its cost as a general expense.

Mr. Scobell said it was necessary to bear in mind what the commission was trying to accomplish in the system of accounts and that the disposition of charges should be made in accordance therewith.

Mr. Edwards then brought up the subject of the creation of a new committee, including the present accounting committee, to take up the large questions concerned in the system of accounts.

Mr. H. W. Peck, of Schenectady, said it seemed as if the association had not taken as much interest in the system of accounts as it should. The fact that only one letter was received in answer to the request of the committee showed that the members had not considered the subject carefully. He hoped that when the subject was considered again the members would appreciate their responsibility in the matter.

Mr. W. W. Freeman, of Brooklyn, said that accounting should reveal the facts regarding the operations of the company. When a question regarding the classification of accounts had arisen he had told the accounting department

to use its own judgment. If there was room for discretion under the system as prescribed, the discretion should be with the company. If the association would show that there are certain elements in the accounts that tend to confuse, he was sure the commission would be ready to consider suggestions. He thought that the treatment of depreciation and amortization was beyond the discretion of the commission. If matters of this nature arose, involving business discretion or business management, he thought that the commission would expect a request for changes to come from the managers and owners of properties rather than from one department of the company.

Mr. J. T. Hutchings, of Rochester, said he felt that the men in the operating departments did not really appreciate the benefits they could receive from the accounting department. The accounting department was not a production department, but simply recorded the facts in such a way as to enable the operating officials to operate more efficiently. A lack of sympathy with this purpose was detrimental to the affairs of the company. Officials were likely to lose sight of the fact that money spent in accounting was the same as money spent in buying coal. He thought that the object of sending an official to a convention or to any city to make an investigation of operating practices was to make him a better operating official, to fit him to reduce his costs and to lead him to see that the company was not run for one department but as a whole. The object of a trip of this nature was to make the entire company render more efficient service. An official of one department must lose his identity for the good of the whole.

It was then moved that the meeting recommend to the executive committee the appointment of a special committee composed of accounting officers, owners, managers and operating officials, and including the present accounting committee, to consider the subject of general and detailed changes in the system of accounts. A report is to be made in writing to the members of the association.

The associations, after passing the resolution, adjourned for lunch, which was served at the Country Club.

The afternoon session was devoted to the consideration of detail questions arising under the system of accounts.

BOSTON MEETING OF THE A. E. S.

A note on the twenty-first general meeting of the American Electrochemical Society in Boston from April 18 to 20 appeared in our last issue. Below are given abstracts of papers and discussions presented on the first day.

UNIFORMITY OF ELECTROCHEMICAL CALCULATIONS.

A paper on "Uniformity in Electrochemical and Electrothermal Calculations," by Dr. Carl Hering, of Philadelphia, Pa., was the first one presented at the Thursday session. The paper urged simplicity and uniformity in such terms, units, expressions, etc., as are involved in calculations of this kind, and the specific simplification recommended by the author is to use as practical units some decimal multiple of the corresponding absolute watt.

All power, no matter in what form it is, should be represented in terms of watts or kilowatts. All forms of energy should be measured in terms of the watt-hour instead of in the calories, thermal units, etc. A third recommendation is to adopt the thermal ohm as the unit of thermal resistance. The thermal ohm is that resistance which allows 1 watt of heat to flow when the difference of temperature is one Centigrade degree. A table of conversion factors was given.

The paper was discussed by Messrs. Griffin, Richards and Whitney.

THERMAL RESISTIVITY AND TEMPERATURE.

A second paper by Dr. Carl Hering dealt with "Effects of the Variations of Thermal Resistivities with the Temperature." The author first discussed the problem in general and then gave a detailed mathematical analysis. One of the chief results of the analysis of the flow of heat through a thermal conductor the two ends of which are held at different temperatures, based on the assumption that the thermal conductivity increases in proportion to the absolute temperature, is as follows:

The proper mean value of the thermal resistivity or conductivity for the conductor as a whole is the value for the mean of the two extreme temperatures. The mean of the two extreme values of the resistivity would give a resistance far too high, but for conductivities this mean is correct. This applies not only to conductors of uniform section, but also to those that flare like the parts of cubical or spherical shells.

In the discussion Mr. FitzGerald thought that, in view of the complicated conditions which govern heat losses by radiation, convection and conduction, it would be unsafe to depend on calculations based on our present data and that it is preferable to depend on experimental results. Messrs. Whitney, Richards, Miller, Duschak, Arsem, Richardson, Sadtler, Thwing and Bray also contributed to the discussion.

HEAT INSULATION.

A paper on "Experiments on Heat Insulation" was presented by Mr. F. A. J. FitzGerald, of Niagara Falls, N. Y. The object of the investigation carried out at the Fitz-Gerald & Bennie laboratories is to determine by comparatively simple experiments what materials for furnace walls give the minimum loss of heat.

The paper gave a preliminary account of a series of comparative experiments made with various refractory bricks (fire brick, silica brick, alundum brick, silicon carbide brick, ordinary red building brick, magnesia brick). The results were given in a series of diagrams, showing the heat losses from a furnace in watts as ordinates and the temperatures as abscissas.

The paper was discussed by Messrs. Hering, Amberg, FitzGerald and Kohn.

HEAT INSULATION.

A paper by Mr. C. P. Randolph, of the General Electric Company, dealt with "The Thermal Resistivity of Insulating Materials."

The method of measurements was described and the results were given in a table for the following materials: different kinds of asbestos, mineral wool, steel wool, "poplox," woolen fibers, "fire roll," cotton, quartz, etc. In the table printed herewith only a few of the results for asbestos are given. The author's table in the paper is quite extensive. *T* is the temperature, *R* the resistivity in thermal ohms per centimeter cube.

	T.	*R.*
85 per cent magnesia-asbestos (the experiments being made in the order given)	100	1475
	200	1508
	300	1503
	400	1430
	500	1425
"Air-cell" asbestos (chars at 300 deg. C.)	100	1091
	200	1008
	300	900
"Long-fiber asbestos" (dried at 350 deg. C.)	500	1390

The paper was discussed by Messrs. Hering, Skinner and Richards.

FURNACE ELECTRODES.

A paper by Mr. R. Turnbull, of Welland, Ontario, dealt with "Furnace Electrodes, Practically Considered." The mixture used in the manufacture of amorphous carbon electrodes is some kind of carbon mixed with pitch and tar. This, after being well mixed together, is molded in some special apparatus to the desired form and then baked

in a furnace in a non-oxidizing atmosphere. The early troubles in electrode manufacture were due to the fact that the results obtained under apparently identical conditions were by no means uniform.

The author thinks this was due to the use of the wrong carbon material. Petroleum coke was first used, but did not work well. This was afterward replaced by retort carbon, which gave better results, but as the retort carbon was collected from gas works all over the world a homogeneous article could not be counted upon. It was only when anthracite coal came into use that real progress was made. Very important progress has been made in recent years in the construction of much larger and stronger electrodes.

TEMPERATURE OF SILICON CARBIDE FURNACES.

A paper by Mr. L. E. Saunders, of the Norton company, gave an account of temperature measurements in the silicon-carbide furnace on a commercial scale. The paper was particularly interesting as it checked up on a large scale former results obtained by Tucker and Gillett on a smaller laboratory scale.

The results are as follows:

	Fire-Sand (Limits).		Crystalline Silicon Carbide (Limits).	
	Formation Deg. C.	Decomposition into Crystalline SiC.	Formation Deg. C.	Decomposition into C and Si.
Tucker and Lampen, 1906....	1650	1950	1950	2220
Same, corrected by Gillett....	1500	1830	1830	2220
Gillett, 1911.....	1540±30	1820±20	1820±20	2220±20
Saunders, 1912.....	1600±50	1840±30	1840±30	2240±5

Mr. Saunders' paper was discussed by Messrs. Bancroft, Amberg, Lidbury, Burgess, Thwing, Whitney, Tucker, Richards and Kohn.

GAS CIRCULATION IN ELECTRIC REDUCTION.

A paper with the above title, by Dr. Joseph W. Richards, of Lehigh University, discussed the method of gas circulation practised at the Jernkontoret electric shaft furnace for pig-iron reduction. Dr. Richards concludes that artificial gas circulation should be dispensed with. The arch of the crucible of the furnace should be protected by water-cooled plates. The limestone flux should be calcined before putting into the furnace. The shaft of the furnace should be provided with auxiliary heating to maintain its contents at or about 400 deg. C.

The paper was discussed in two communications by Mr. Leffler, of Sweden, and Mr. Noble, of California.

SUPPLY OF ENERGY TO ELECTRIC FURNACES.

A paper by Mr. W. Sykes dealt with the supply of energy to electric furnaces for refining iron and steel. A great development is to be expected in this field in the near future, but "before it can be entirely successful it will undoubtedly be necessary to modify certain features in the construction so as to allow of using larger furnaces than are now employed."

The author first discussed some features of arc furnaces and emphasized that the reactance must be limited as much as possible and that before handling larger currents some structural changes will be necessary to avoid running the conductors close to iron supports, etc., and also to reduce their length.

As to induction furnaces with a low power-factor, he recommended, in the case of a new installation, to install generators with a large kilovolt-ampere rating compared with the size of the prime movers. If the generating plant is already installed, two other methods are available. One is to use a motor-generator set with a low-frequency generator, or one of large kilovolt-ampere rating, and the other to use a synchronous condenser which will compensate for the low power-factor of the furnace.

Resistance furnaces can be used for steel refining only in limited sizes, on account of the difficulties of handling the very large currents necessary.

After a brief discussion of the electric pig-iron furnace the author dealt with the cost of energy generation from water or coal and emphasized that the cost of energy is by no means the principal item in the expense of electric steel refining.

ELECTRIC FURNACE FOR HEATING BARS AND BILLETS.

Mr. Thaddeus F. Baily presented a paper on "Further Development of Electric Furnaces for Heating Bars and Billets" from actual practice. The furnace of which particulars were given has an output rating of 276 lb. of metal per hour and the kilowatt-hour consumption is 0.25 per lb. The metal is charged at 60 deg. Fahr. and discharged at 2360 deg. Fahr., the time in the furnace being twenty minutes.

HIGH-TENSION EQUIPMENT FOR ELECTROCHEMICAL PLANTS.

Mr. J. Rattray Wilson, of Niagara Falls, presented a paper reviewing the various features of the now thoroughly standardized high-tension part of the electrical equipment of electrochemical plants, the chief requirements of arrangement and construction being "foolproofness" and easy accessibility.

In the vicinity of Niagara Falls the energy is delivered at a tension of from 11,000 to 12,000 volts, and until recently it was all brought to the consumer's premises on overhead cables. On the American side the overhead construction is largely being done away with, the conduit system taking its place. This alteration saves a great deal of trouble, as it eliminates to a very large extent the heavy surging from lightning or other external causes. Details of the wiring and the protection devices of the high-tension circuit were given. Great stress was laid on the necessity of installing as heavy and good a main oil circuit-breaker as possible. In connection with the transformer installation the use of a water rheostat, placed between the disconnecting switches and the transformers, was recommended, a special, single-pole, oil circuit-breaker being used to short-circuit. Where transformers have to be started under full load this rheostat is of great importance and convenience.

In a communicated discussion Mr. J. L. Harper explained in detail why at the present time it is believed to represent good judgment, in all except long overhead lines, to consider most protective devices as causing more trouble than they are worth, to make a study of the factory ends of the distributing lines in order to produce a minimum of fluctuations, surges or unbalancing conditions, and to develop and use, both in the central station and at the receiving end of the lines, switches having a rating commensurate with the whole rating of the generating plant back of them.

Abstracts of the papers and discussions at the Friday and Saturday sessions will appear in a following issue.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION, FIRST DISTRICT.

For the first time in its history the Public Service Commission for the First District has gone into court to ask for a writ of mandamus to compel obedience to its orders. The case was that of the Bridge Operating Company, which the commission recently ordered to reduce its rates of fare

for local transportation over the Williamsburg Bridge. This company, under a contract with the city made by the bridge commissioner in 1904, is charging 3 cents for a single ride over the bridge and 5 cents for two rides. Its reports to the commission showed that for the last two years, on a capital of $100,000, it had been earning 112 per cent. After public hearings the commission issued an order directing the company to reduce its charges to 2 cents for a single fare or three tickets for 5 cents. The company notified the commission that it would not obey the order and asked for a rehearing. The commission denied the rehearing and directed its counsel to apply to the Supreme Court for a writ of mandamus to compel obedience to the order. Application was made to the Supreme Court in Brooklyn, and the case will soon be heard.

The commission has asked the Board of Estimate and Apportionment to appropriate $40,000 for the purpose of installing additional elevators at the 181st Street station of the Broadway branch of the subway. In 1907, the first year after the opening of the 181st Street station, there were 1,378,181 tickets sold at the station. In 1911 the ticket sales had grown to 4,413,636 tickets.

On Tuesday of this week the commission will open bids for the construction of Section 14 of the Lexington Avenue subway. This section, which runs under the Harlem River, connects the Manhattan part of the Lexington Avenue subway with its extensions in the Bronx. The subway will be carried under the river in four tubes, either of steel or cast iron, the contractors having the option of bidding on either type.

NEW YORK COMMISSION, SECOND DISTRICT.

The Public Service Commission, Second District, has ordered a general inquiry and investigation into the routing, service, facilities, rules, regulations, practices and methods and the condition of lines and cars of the United Traction Company in the city of Albany and vicinity, including the traffic between Troy and Albany and Troy and Rensselaer.

The commission has made an order requiring the Oswego River Power Transmission Company to show cause before the commission at Albany on May 27 why it should not direct its counsel to commence an action or proceeding in the Supreme Court in the name of the commission for the purpose of having the company prevented by a mandamus or injunction from transmitting electricity over and across public streets and selling and furnishing the same to persons and corporations in the city of Fulton without the permission, consent or approval of the commission. On March 28, 1911, the commission denied the application of the company for permission to exercise franchises in the city of Fulton, and the Fulton Light, Heat & Power Company, which now serves that community, has complained to the commission that the Oswego River company is actually transmitting electricity through its wires and selling it to persons and corporations, and has asked the commission to enjoin and prevent that company from doing so, further praying that the company be required to remove its poles, wires and electrical construction from the city.

The commission has ordered a public hearing upon the complaint of the Postal Telegraph-Cable Company against the New York Telephone Company, alleging that the telephone company is by illegal discrimination diverting to the Western Union Telegraph Company telegrams which are intended for the Postal company.

MASSACHUSETTS COMMISSION.

The Gas and Electric Light Commission recently gave a hearing upon the petition of the Lowell Electric Light Corporation for authority to issue 1534 shares of additional stock, at $150 per share, to meet the cost of extensions and improvements. In the course of the hearing it developed that the company carries a bond sinking fund as a liability. Another point raised at the hearing was the practice of the company in relation to charging the cost of electric trucks for its own service to the capital account. The company recently replaced all its horses and wagons by electric trucks, as noted in the *Electrical World* of April 20, page 751, and marked economies have resulted. It was pointed out that, while the item of electric trucks was included in the statement of capital expenditures to be met by disposing of additional stock, the company asks permission to capitalize only $175,000 out of $216,000 total outlay for additions in four years. An issue of bonds was not favored on account of the resulting tendency to depress the selling price of the stock. It was claimed that the company is administered on the theory that an addition to the property is an appropriate charge to capital, but its renewal or replacement is not. In the case of the electric trucks a deduction was made for the salvage of the horse-drawn equipment. Representatives of the city occupied the rest of the hearing, speaking in opposition to an increase of capital at the present time. In the course of the discussion Chairman Barker pointed out that a policy of providing for all extensions out of income is in conflict with the policy of a steady reduction in the price of the product.

MARYLAND COMMISSION.

In an opinion handed down last Saturday by the Maryland Public Service Commission, the complaint of the Baltimore Electrical Supply Company and other electrical contractors against the Consolidated Gas, Electric Light & Power Company regarding the sale by the latter company of electrical appliances and the wiring of houses is dismissed. The opinion states that to one of the constituent companies of the present consolidation the right to do the business complained of was expressly given, and that under the terms of the merger this right inheres in the present company. It also states that there can be no doubt at this time that the general public benefits by the operations of the Consolidated, whatever may be the effect upon the individual contractors. As to the argument of the contractors that the Consolidated is now cutting rates and will make up the losses when competition shall have been eliminated, the commission says that the public service law applies to this branch of the company's functions as well as to the others, and that the public may at any time seek redress before the commission for unfair charges.

The commission received petitions last week from the Consolidated Gas, Electric Light & Power Company and the Baltimore County Electric Company for approval of the plans of the Consolidated Company for taking over the electric properties of the Baltimore County Company. It it proposed that the Baltimore County Water & Electric Company shall sell the properties to the Baltimore County Electric Company for the entire issue of $150,000 in capital stock and $221,000 in first-mortgage 5 per cent forty-year gold bonds of the latter company, and thereupon resell the securities thus acquired to the Consolidated Company for cash. This will give the Consolidated complete ownership of the Baltimore County Electric Company, and the commission was asked that the latter company be allowed to lease its property and plant to the Consolidated, which would amount to amalgamation. If the plan is approved, the cash realized by the Baltimore County Water & Electric Company—$371,000—will be applied to the extensions and betterments of the water plant of the company.

Hearings in the case of the Patapsco Electric & Manufacturing Company against the Consolidated Gas, Electric Light & Power Company were concluded last week. Attorneys for both companies received permission to submit briefs. During the hearing last week Mr. Robert Biggs, attorney for the Patapsco company, attempted to prove the existence of a connection between the Consolidated company and the Mount Washington Electric Company. Mr. Thomas G. Offutt, president of the latter company, denied that the Consolidated company manipulated or even influenced its rates.

VERMONT COMMISSION.

The Public Service Commission will give hearings in the near future on applications for authority to issue stock or bonds in the cases of the Clarendon Power Company, the Burlington Traction Company and the Newport Electric Light Company.

NEVADA COMMISSION.

The city of Ely has petitioned the Public Service Commission of Nevada for a reduction of the rates charged by the Ely Light & Power Company. At the public hearings in Ely, which were presided over by Chief Commissioner H. F. Bartine, testimony was taken for four days. Among those examined was Mr. L. B. Hedge, chief electrician of the Ely Light & Power Company, who testified in regard to the methods of valuing the property and making rates. Mr. E. Opdyke, bookkeeper for the company, was examined at length in regard to the methods of accounting. County and city tax assessors were also examined in regard to property values. A decision is not expected before the middle of July.

CALIFORNIA COMMISSION.

The Railroad Commission of California, which is vested with the powers of a state public service commission, has issued a general order directing any public-utility corporation which may have raised its rates since Oct. 10, 1911, to restore immediately the rates which were in existence at that time. The commission points out that by the public utilities act the public utilities of the State, other than common carriers, have no right to charge rates or tolls in excess of those actually charged on Oct. 10, 1911. The provision fixing Oct. 10, 1911, as the date on which the act became effective, so far as rate raising is concerned, was inserted in the law to prevent companies from raising rates before the Railroad Commission assumed jurisdiction. The commission actually began its duties as the general public service commission on March 23, 1912, and any public utility which subsequent to the latter date has collected a rate higher than that in effect on Oct. 10, 1911, must report the facts to the commission immediately.

Current News and Notes

DOHERTY MANAGERS TO MEET IN DENVER.—The annual conference of the managers of the properties operated by H. L. Doherty & Company will be held in Denver, June 4 to 12 inclusive.

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COVINGTON OIL ENGINES.—On page 964 of our issue dated May 4 it was erroneously stated that the Covington oil engines there described were built in Covington, Ky., the engines having been built at Covington, Va.

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HEATING ASSOCIATION CONVENTION.—The National District Heating Association will hold its fourth annual convention in Detroit, Mich., on June 25-27. The secretary of the association is Mr. D. L. Gaskill, Greenville, Ohio.

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EXHIBITS AT N. E. L. A. CONVENTION.—Nearly all of the available seventy booths at the Seattle convention of the National Electric Light Association have already been taken. The booth area covers 8150 sq. ft. in the State Armory. The secretary of the exhibition committee is Mr. Walter Neumuller, 55 Duane Street, New York.

* * *

TELEPHONE METERS.—Prof. E. W. Bemis, expert employed by the city of Chicago on public-service rates and problems, has declared in a preliminary report that in his opinion satisfactory meters to record the number of telephone calls from measured-rate stations are not now available. He recommended that the city take no action at the present time in reference to the installation of meters.

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DE LUXE STREET CAR.—In the issue of the *Electrical World* dated April 27 it was stated that an elaborately equipped car for pleasure parties had been placed in service by the Pittsburgh & Butler Street Railway Company. We have been informed since that date that this car is owned and operated by a different road having a somewhat similar name, the Pittsburgh, Harmony, Butler & New Castle Railway Company.

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SENATE BILL REGULATING WIRELESS TELEGRAPHY.—On May 7 the Senate passed a bill to regulate radio-communication. This measure upholds the Berlin convention, which was recently ratified by the Senate, and makes it necessary for any person, company or corporation within the jurisdiction of the United States that desires to use or operate any apparatus for wireless communication in interstate commerce, or on any vessel of the United States engaged in such commerce, to take out a license issued by the Secretary of Commerce and Labor. Violation of the act is made a misdemeanor punishable by a fine of $500 and confiscation of the apparatus. Licenses can be issued only to citizens of the United States. The President receives authority to close any wireless station in time of war or public peril, or to appropriate such a station for public use. Action on this bill was hastened by the *Titanic* disaster.

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INTERNATIONAL TESTING MATERIALS CONGRESS.—The sixth congress of the International Association for Testing Materials will be held in the Engineering Societies Building, New York, on Sept. 2-7, 1912. Delegates have been appointed by the governments of Great Britain, France, Spain, Sweden and Switzerland and by numerous engineering societies in England and the United States. On the evening of the opening day an informal reception will be held under the joint auspices of the American Society for Testing Materials, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers. Over 150 reports and papers are now in hand or promised, about thirty-five of which have been prepared by Americans. The congress fee will be $5 for members and delegates. The president of the association is Dr. Henry M. Howe, and the secretary is Mr. H. F. J. Porter, 1 Madison Avenue, New York.

* * *

SUIT FOR DISSOLUTION OF STEEL CORPORATION.—Hearings were begun on May 6 in the custom house, New York, in the suit of the government for dissolution of the United States Steel Corporation, before Henry T. Brown, the examiner appointed by the federal court for the district of New Jersey. The contention made by the government in this suit is that all the principal companies which were merged into the United States Steel Corporation were themselves combinations in restraint of trade. Jacob M. Dickinson, ex-Secretary of War, and Henry E. Colton appeared for the government. Investigation of the American Steel & Wire Company, one of the constituent companies, was first taken up, and the defendants admitted that this company was a member of the Wire Rope Association, the Rubber-Covered Wire Association, the Horseshoe Manufacturers' Association, the Underground Power Cable Corporation, the Bare Copper Wire Association, the Weather-Proof and Magnet Wire Association, and the Lead Incased Rubber Cable Association, but denied that it entered these associations with the sanction or authority of the Steel corporation. Examination of the relations of the constituents will be made. It is expected that the hearings will last at least two months, and that the suit will go ultimately to the Supreme Court.

Cosmopolitan Electric Company Section of N. E. L. A.—Employees of the Cosmopolitan Electric Company of Chicago to the number of 150 accepted the company's invitation to dinner on May 2 and formed the Cosmopolitan Electric Company Section of the National Electric Light Association, under the leadership of Mr. H. E. Niesz, general manager of the company. The section has now 150 members. It will meet monthly and is demonstrating its capacity for work and play by establishing a library in the power house and by organizing a baseball nine. The section officers are: Chairman, Mr. James H. Delany; vice-chairman, Mr. Edward Gilroy; secretary, Mr. C. F. Brown; treasurer, Mr. H. A. Weigle; executive committee, the officers named and Messrs. C. B. Johnson, Ira Hampton and C. Wickham. This is the third company section of the N. E. L. A. to be organized in Chicago, the others being connected with the Commonwealth Edison Company and the Public Service Company of northern Illinois.

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The Relation of Light to Shadow and Color in Design.—At a special joint meeting of the New York Chapter of the American Institute of Architects and the New York Section of the Illuminating Engineering Society on May 2 a paper by Messrs. Henry Hornbostel and Bassett Jones, Jr., entitled "The Relation of Light to Shadow and Color in Design," was presented and strikingly illustrated by means of models, color booths and stereopticon views. The paper contained an excellent presentation of the facts and relations upon which architectural beauty depends, special emphasis being placed upon harmony in design. By means of models illuminated with light coming from various directions it was shown that the effectiveness of design depends to a surprising extent upon the direction from which the light is obtained, while diffusion of light has the effect of flattening and destroying the beauty of unicolored relief work. By means of colored screens, pigments and colored papers the authors showed the effect of both additive and subtractive combinations of colors, the tendency in the former case being toward white and in the latter case toward black.

* * *

Prize Contest Instituted by the George Montefiore Foundation.—A recent communication from the Association of Electrical Engineers composed of alumni of the Montefiore Electrotechnical Institute, of Liège, Belgium, announces the competition for a prize to be awarded in 1914 by the "Foundation George Montefiore Levi." The prize, which is awarded triennially and was first bestowed in 1911, is for the best original paper on the advancement in electrical science or the progress in the electrical arts. A sum of 150,000 francs has been set aside, at 3 per cent annual interest, of which the income is available for the prize. Award will be made by a jury of ten electrical engineers, consisting of five Belgians and five foreigners. Those who are interested can obtain a circular giving full information by addressing O. De Bast, president of the Montefiore Institute. The last meeting of the Montefiore jury, as alluded to above, was in September, 1911, at Liège, Belgium. It was ably presided over by Professor Eric Gerard, of the Montefiore Electrotechnical Institute. The other four Belgian electrical engineers were Messrs. Banneux, de Bast, Libert and Roselle. The five foreign electrical engineers were Messrs. Boucherot, Ciconia, Kapp, Kennelly and Kitler.

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SOCIETY MEETINGS.

Steinmetz N. Y. E. S. Lecture.—At a meeting of the New York Electrical Society to be held in the Engineering Societies Building, New York, on May 15 Dr. C. P. Steinmetz will deliver a lecture on *Wave Motion*.

Annual Convention of I. E. S.—The annual convention of the Illuminating Engineering Society for 1912 will be held at Niagara Falls, Canada, on dates not yet selected. Mr. Norman Macbeth has been appointed chairman of the convention committee.

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Canadian Electrical Association Convention.—The 1912 convention of the Canadian Electrical Association will be held at Chateau Laurier, Ottawa, on Wednesday, Thursday and Friday, June 19-21. The secretary of the association is Mr. T. S. Young, 220 King Street West, Toronto.

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A. S. M. E. New York Meeting.—Various methods of recording and reproducing speech with particular reference to the increase of practical efficiency in handling dictation in offices will be discussed in a paper to be presented by Mr. A. J. McFaul before the American Society of Mechanical Engineers in New York on May 14.

* * *

A. I. E. E. Convention.—The headquarters of the American Institute of Electrical Engineers during its annual convention, to be held from June 24 to 28, will be at Hotel Somerset, Boston. A committee on hotel arrangements, of which Mr. L. D. Gibbs, 39 Boylston Street, Boston, is chairman, will take full charge of the hotel accommodations for the members and guests of the Institute.

* * *

Rate Research for N. E. L. A.—At the last meeting of the rate research committee of the National Electric Light Association, held in New York, the report to be presented at the Seattle convention was ordered printed. The committee also decided to be represented in the Commercial Section exhibit at the convention. An informal dinner for the member-company assistants of the committee will be given in Seattle on June 11.

* * *

Washington Meeting of the A. I. E. E.—The Washington Section of the American Institute of Electrical Engineers postponed indefinitely its meeting scheduled for April 30 on account of the death of Vice-president Parsons of the General Electric Company. Mr. Charles W. Stome, manager of the lighting department of the General Electric Company, was to have addressed the section on the subject of *Some Problems in Substation and Central Station Operation*.

* * *

Los Angeles Aqueduct Transmission.—An important step toward the construction of transmission lines to bring electrical energy from the hydroelectric development of the Los Angeles Aqueduct into that city was taken on April 26, when the Board of Public Works of Los Angeles applied to the United States government for rights of way across government lands for transmission of electric energy and for telephone lines in Kern National Forest, a part of the National Forest Reservation and also in the Independence land district. The application covered about 180 miles of rights of way.

* * *

Illuminating Engineering Society, Philadelphia Section.—The Philadelphia Section of the Illuminating Engineering Society will hold its regular monthly meeting at 1000 Chestnut Street on Friday, May 17, at 8 p. m., at which time there will be the annual election of section officers for the year 1912-1913. The paper of the evening will be delivered by Prof. A. J. Rowland, on *The Essential Principles of Illumination*, embracing Talk No. 4 on "Calculation of Illumination" and Talk No. 5 on "Principles of Photometry." These talks will be illustrated by practical demonstrations and lantern slides and will complete the course. Preceding the meeting a special dinner will be served at the Bingham Hotel at 6 p. m.

NEW HYDROELECTRIC PLANT OF THE SHAWINIGAN WATER & POWER CO.—II.

100,000-Volt Transmission System of the New Hydroelectric Development at Shawinigan Falls and Substation Details.

87-Mile Transmission Line Erected in Seven Months—Construction Details of Steel Tower Line Carrying 19-Strand, 250,000-Circ. Mil Aluminum Conductors—Substation Transforming and Auxiliary Equipment—Safety Measures.

BY JULIAN C. SMITH AND F. T. KAELIN.

DURING last year the Shawinigan Water & Power Company completed its second hydroelectric power development at Shawinigan Falls, with transmission lines and substation at Montreal. This new plant was described in the issue of May 4. The present article gives a description of the transmission system and the substation.

TRANSMISSION LINE.

The two 100,000-volt transmission lines from Shawinigan Falls to Montreal have each a normal capacity of 12,500 kw. The transmission line is 87 miles long and is erected on a private right-of-way 100 ft. wide, with 867 steel towers. The three wires of each circuit are arranged in vertical plane on each side of the tower and carried on suspension insulators. The vertical spacing of the wires is 8 ft., and conductors consist of 19-strand aluminum cable, 250,000 circ. mil. For lightning protection two galvanized stranded steel cables of ⅜-in. diameter are strung on the top cross-arm of the towers about 32 ft. apart.

TOWERS.

There were two types of standard towers used, a light-section tower and a heavy-section or strain tower. The standard distance between towers is 520 ft., but there are spans across the rivers up to 1400 ft. with special high towers. Every tenth tower is a strain tower. The insulators on the strain towers are of the same type as the regular suspension insulators, but of eight units instead of seven. The standard tower has a total height of 70 ft. 7 in. and at the base is 19 ft. x 19 ft. square. It weighs 4800 lb. The strain towers are a little shorter, but otherwise of the same general construction and dimensions as the light towers. Their weight is 6200 lb. The towers are made up entirely of open-hearth steel, hot-galvanized. All the fittings and bolts used in connection with the towers are also galvanized. The light towers are designed to stand a breast pull of 15,000 lb. applied across or along the lines at the intersection of the upper cross-arm at the level of insulator supports, and the heavy-section towers will stand a pull of 30,000 lb. The light-section towers have been used in spans up to 650 ft. and on angles less than 2 deg. For longer spans and greater angles heavy-section towers have been used, and for angles greater than 60 deg. special angle towers have been used.

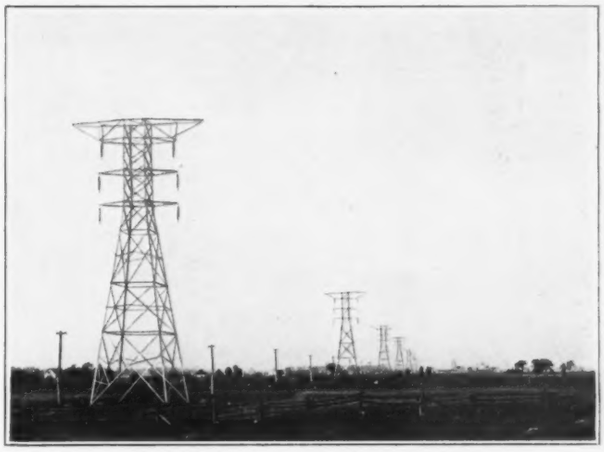


Fig. 18—Section of Transmission Line.

Each tower is grounded with a copper wire connected to the steel by means of a Dossert rail bond. The ground plate consists of a copper plate embedded in pulverized charcoal. All steel towers are anchored on each leg to a concrete foundation 6 ft. deep and 3½ in. square at the bottom, tapering to a square or round top of about 15 in. in diameter. The tower legs are bolted to this concrete foundation with two 1⅛-in. steel bolts, which extend the whole length of the 6 ft. of concrete foundation.

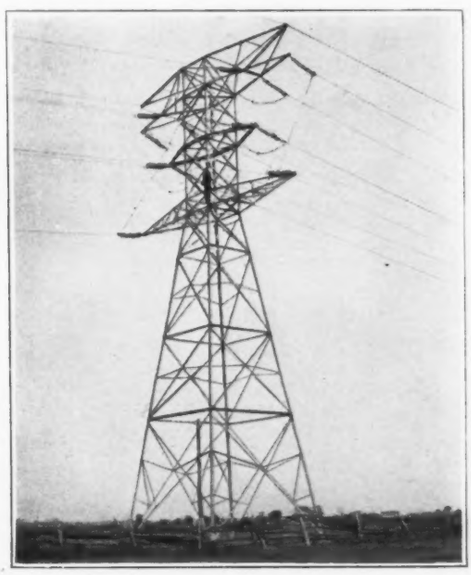


Fig. 17—Transposition Tower.

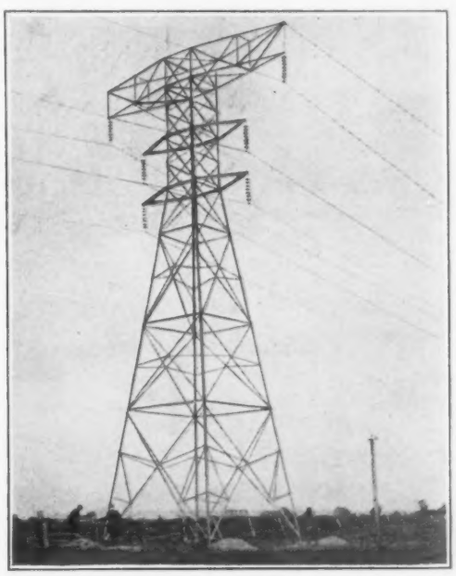


Fig. 19—Combination Tower.

The foundations for the strain and special towers are of the same type, but proportionately heavier. The maximum sag for the standard span is 21½ ft. and the minimum clearance between wire and ground 24 ft. In stringing wires dynamometers have been used to check the actual

stresses with the calculated stress and also to determine sag at certain temperatures. For the long spans across the river No. 000 B. & S. copper cable has been used in order to decrease the sag.

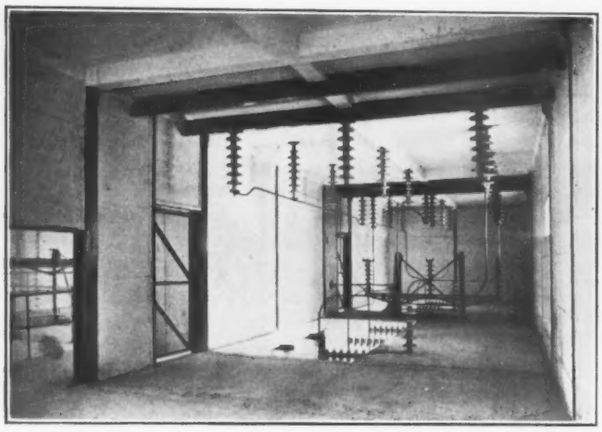


Fig. 20—High-Tension Busbar Room in Terminal Station at Maisonneuve, Montreal.

The work on the transmission line was started at the end of February, 1911, and completed Oct. 15, and power at 100,000 volts was transmitted for the first time on Nov. 9, 1911.

building through projecting hoods. The general lay-out of the high-tension wiring, circuit-breakers, disconnecting switches, etc., is similar to that in the power house. Each transmission line with its high-tension wiring in the station,

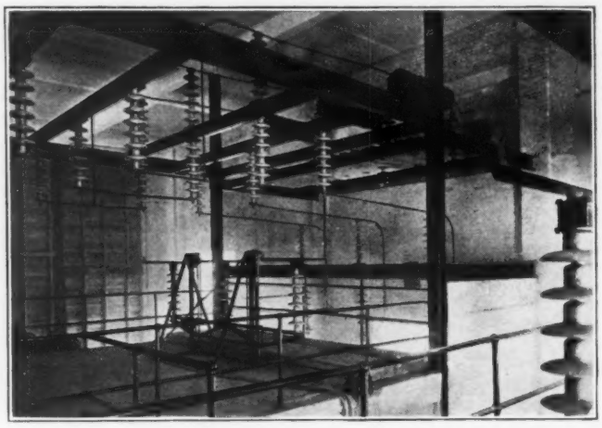


Fig. 22—Line Entrance Bushings, Disconnecting Switches and Choke Coils.

step-down transformer, low-tension busbar, etc., forms a separate unit, and its apparatus are separated from those of the other units by partition walls. The substation is built for three three-phase, 12,500-kva transformers to step down

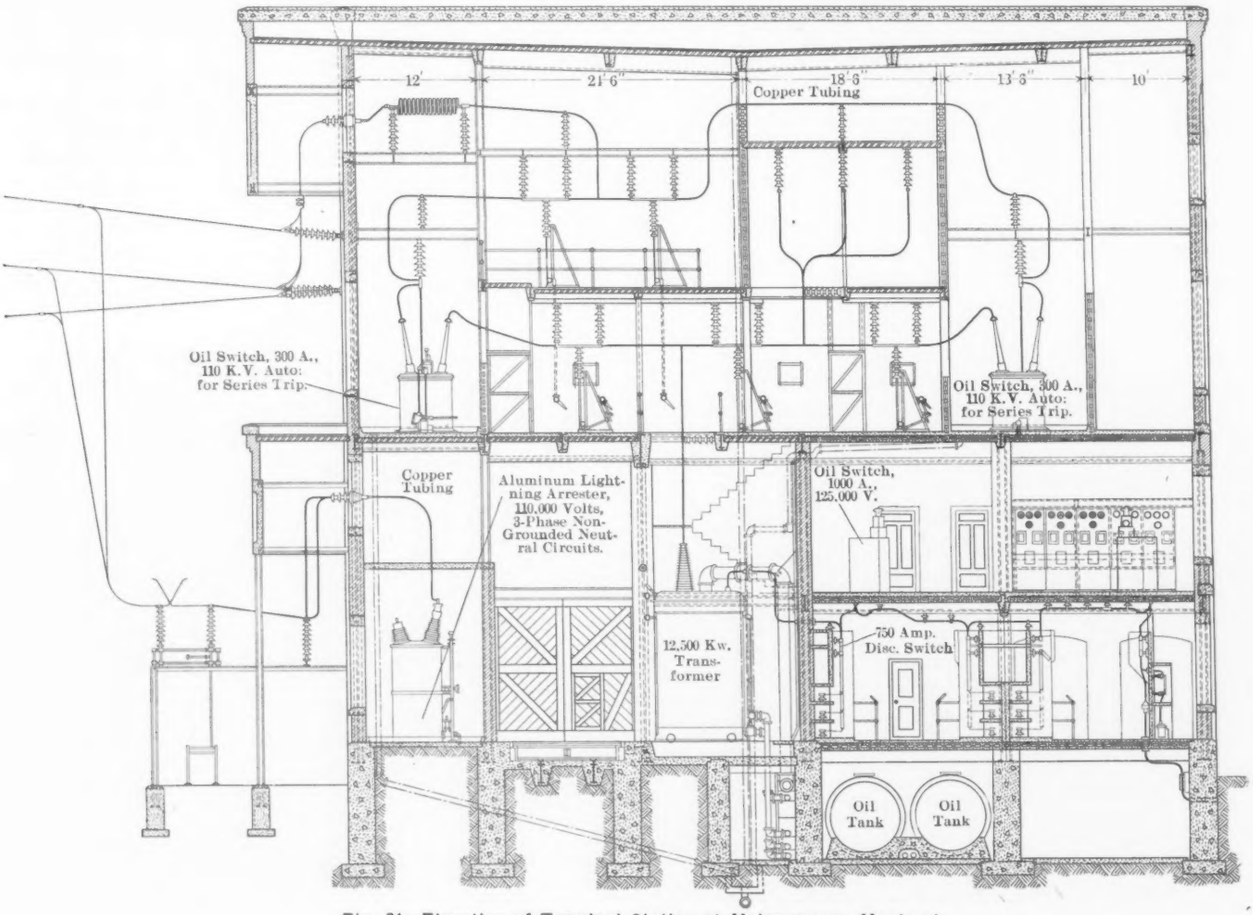


Fig. 21—Elevation of Terminal Station at Maisonneuve, Montreal.

SUBSTATION AT MAISONNEUVE.

At the end of the two transmission lines a substation for reducing the tension to 12,500 volts was erected. This substation is located on Orleans Avenue in Maisonneuve, a suburb of Montreal. The two transmission lines enter the

the tension from 85,000 volts to 12,500 volts. At present only two transformers are installed.

The station is equipped with a 75-ton hoist to facilitate the handling of the transformers. The transformers can be rolled out by means of a truck to the end of the building

where this hoist is installed. The first floor of the station is occupied on one side by transformers and electrolytic lightning arresters and on the other side by 12,500-volt buses and disconnecting switches for the feeders.

SUBSTATION BUS STRUCTURE.

These low-tension busbars are separated from each other and from the adjacent bars by heavy concrete barriers. All

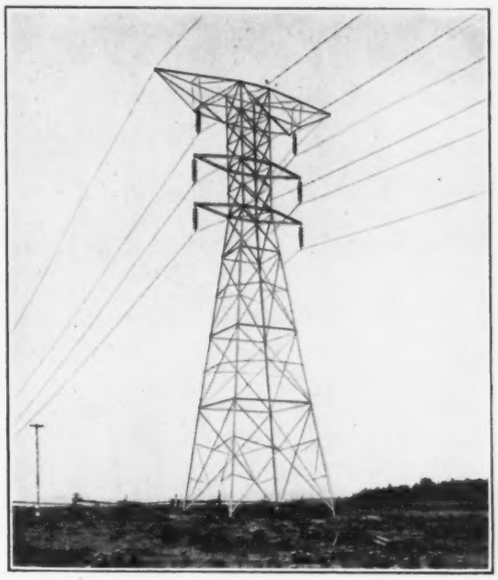


Fig. 23—Transmission Line Tower, Light Section.

parts of the equipment, such as busbars, busbar chambers, etc., are covered by asbestos doors, which are locked in position, but which can be readily removed in case it is necessary to get inside the busbar chambers. The busbar chambers and disconnecting switches are designed so that the only exposed live parts are not less than about 8 ft. from the floor. There is ample room for a man handling these knife switches to get a sufficient distance away so that in case of trouble he will not be injured.

SUBSTATION SAFETY MEASURES.

Another detail involving the safety of the operators and the proper operation of the station is the locking of the 12,000-volt switches. The ordinary knife switches may be thrown open by reason of the reaction which takes place

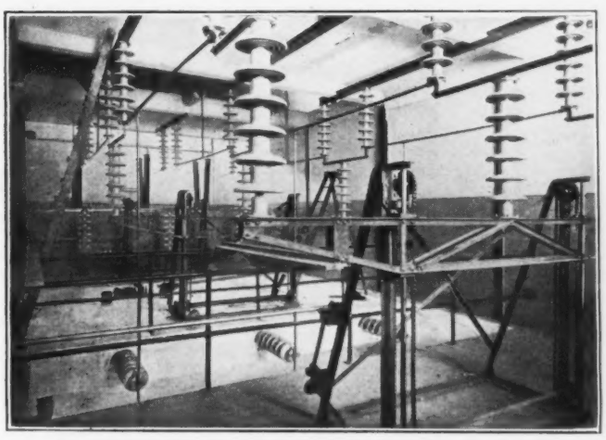


Fig. 24—High-Tension Disconnecting Switches and Oil Switch.

between the current passing through the blade and the magnetic field which is generated around the blade. These switches are occasionally opened up at the time they carry the maximum current, and the results are that the switches and the surroundings are often very badly damaged by the intense heat of the arc. This lock-type switch is locked in the closed position by a kind of wedge, which at the same time forces the contacts together and thereby assures that the switches will operate at a low temperature and will not be thrown out under heavy current.

CONTROL.

The main operating room is on the second floor. Here

Fig. 25—Auxiliary Transformer Switches.

the operator controls the transformer circuits, the 100,000-volt oil switches on the transmission line and transformers from the benchboard. Directly behind the operator are mounted totalizing panels which show by indicating and graphic recording meters the total amount of power supplied by each transformer unit to the outgoing feeders.

Mounted along the room opposite groups of feeder switches are the panels controlling the different feeders. Each of these feeders is equipped with a little device which, if the switch trips out, will light a lamp on the benchboard and at the same time ring the bell to bring the operator's attention to the fact that the switch has tripped out. There

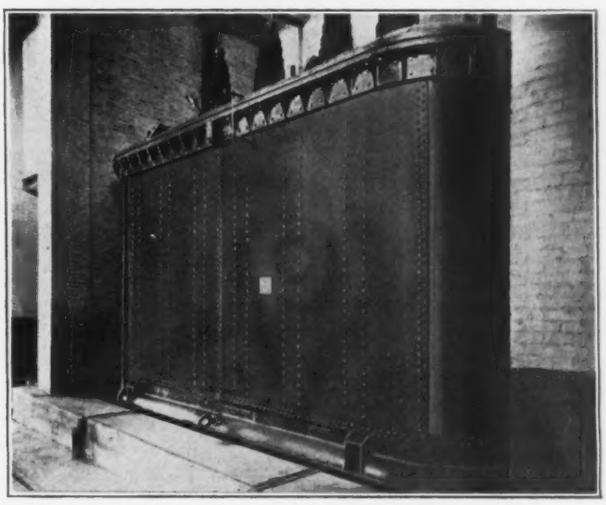


Fig. 26—12,500-kva Step-Down Transformer.

are also two extra panels and two extra oil switches on the 12,500-volt side, which are provided to take care of what are called tie lines between the old terminal station and the new one.

The old terminal station is supplied from the old power

house at Shawinigan Falls with 30-cycle energy and is equipped with motor generators to change the frequency from 30 to 60 cycles. All the 60-cycle energy from the old and new substation is delivered to the Montreal Light, Heat & Power Company for further distribution. In order to join the two substations together, it is necessary to synchronize the two stations, and therefore the tie switch panels in the new station are equipped with synchronizing lamps and synchroscopes.

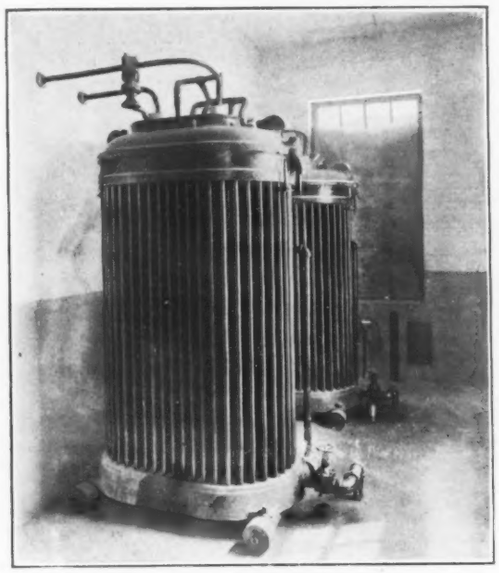


Fig. 27—Auxiliary Transformers.

It is interesting to note that the water-power stations, which are located, measured along the transmission line, a distance of 170 miles apart, are synchronized by an operator in Montreal, who has no control over the voltage and frequency of either station other than by informing the men in the stations as to the conditions desired. As a matter of fact, this synchronizing is done without any difficulty at all, and in two or three minutes after the switches are set ready for synchronizing the final switch can be closed and the two stations operated in parallel.

The high-tension wiring consists of 1-in. copper tubing and the low-tension busbar of copper bars 3 in. x ¼ in. All the connections between cables, disconnecting switches, oil switches and low-tension busbars, also between disconnecting switches, oil switches and high-tension busbars, are made with Dossert connectors. These connectors form a mechanical connection without soldering. They save considerable labor and time in the erection of the apparatus and afford easy facilities for disconnecting circuits in case of trouble or when temporary connections are required.

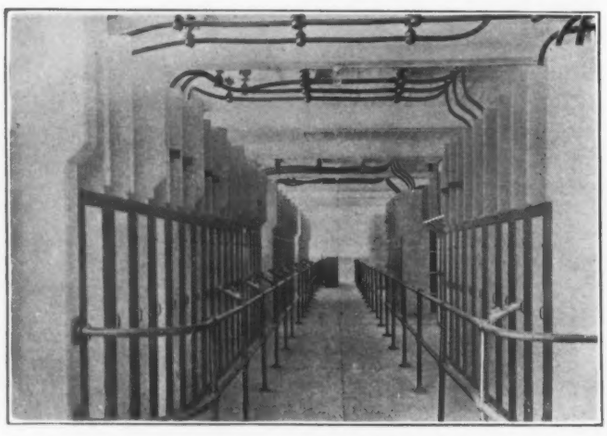


Fig. 28—Low-Tension Switchboard.

SUBSTATION AUXILIARY EQUIPMENT.

In the basement is located the auxiliary equipment, consisting of a storage battery for operating the oil switches in case of an interruption of the main circuit. This storage battery consists of 66 cells having a normal voltage of 125 volts and a normal discharge rate of 200 amp for one hour. With the storage battery is a small motor-generator set which can be used for the operation of the oil switches or for charging the battery. In the basement also are the oil tanks for transformer oil consisting of six tanks having a capacity of 5000 gal. each. There are also two small tanks for the oil switches and lightning arresters.

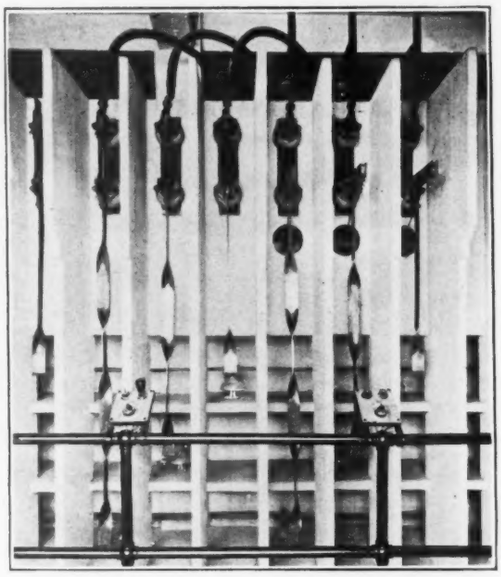


Fig. 29—Feeder Disconnecting Switches and 12,500-Volt Buses.

The cells in which the high-tension oil switches are installed are provided with sewer connections and provision is made so that in case of an explosion of the tank the oil cannot spread outside the cell but can escape to the sewers. As a part of the equipment for handling the oil there are two pumps, the main centrifugal pump for handling the transformer oil from the tanks up to the transformers and the small filter press outfit for filtering and drying the oil. The pumps for circulating water to the transformer cooling coils are installed in the basement. This water is taken from a tank outside the building to the pumps and is forced through the transformers and back again into the

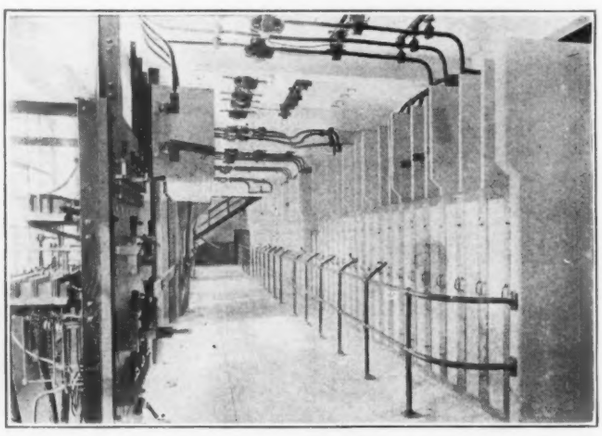


Fig. 30—Feeder Disconnecting Switches.

tank, into which it is sprayed for the purpose of cooling it. The substation building is 125 ft. long, 80 ft. wide and 70 ft. high, including the basement, and is built entirely of fireproof material. The steel-work construction is mostly incased in concrete. The partition walls around the 100,000-volt wiring and oil circuit-breakers are of reinforced concrete, and the outside walls are of brick. The work on this substation was started last April, and the station was put into operation the beginning of November.

SUMMARY.

The main turbines and exciter turbines in the power house were built by the I. P. Morris Company, Philadelphia, Pa.; the generators and exciters by the Canadian Westinghouse Company, Hamilton, Ont., and the step-up and step-down transformers by the General Electric Company, Schenectady, N. Y. The penstocks were made and erected by the John Inglis Company, Toronto, Ont., and the cranes in the power house, gate house, substation and the skidway car and hoist were furnished by the Whiting Foundry Company, Harvey, Ill. The aluminum cables for the transmission line were made by the Northern Aluminum Company, Shawinigan Falls, Quebec, and the insulators by the Ohio Brass Company, Mansfield, Ohio. The transmission-line towers were furnished by the Canadian Bridge Company, Walkerville, Ont.

The complete hydroelectric plant was designed and built by the engineering staff of the Shawinigan Water & Power Company. The following are the principal engineering officers of the Shawinigan Water & Power Company: Mr. Julian C. Smith, chief engineer; Mr. F. T. Kaelin, assistant chief engineer; Mr. R. J. Beaumont, chief draftsman, and Mr. John Morse, operating superintendent.

COST OF CHANGING TWO-PHASE INDUCTION MOTORS TO THREE-PHASE.

A small central station in the West recently changed its entire distribution system from two-phase to three-phase, retaining the original frequency of 60 cycles. This made it necessary to rewind all two-phase motors connected to the system. There were ten of these motors, ranging from 2 hp to 25 hp, all operating at 220 volts. For the benefit of those who may have similar problems confronting them we publish herewith a table showing the actual cost of doing this work, as furnished by the central station company.

COST OF REWINDING POLYPHASE INDUCTION MOTORS.

Motor.	Labor.	New Coils.	Miscellaneous.	Total
25 hp, 1200 r.p.m.	$11.92	$45.00	$2.64	$59.56
15 hp, 1200 r.p.m.	19.08	21.32	3.52	43.92
10 hp, 1200 r.p.m.*	24.07	16.82	4.44	45.33
5 hp, 1800 r.p.m.	3.56	....	0.82	4.38
5 hp, 1800 r.p.m.	2.40	....	0.63	3.03
5 hp, 1800 r.p.m.	2.40	....	0.62	3.02
5 hp, 1800 r.p.m.	2.40	....	0.51	2.91
3 hp, 1800 r.p.m.*	7.47	....	1.68	9.15
3 hp, 1800 r.p.m.	1.60	....	0.40	2.00
2 hp, 1800 r.p.m.	3.78	....	0.68	4.46

*Extra time was required owing to errors in blueprints.

The winders received 40 cents per hour and their helpers from 34 cents to 42 cents per hour. The motors were of two standard and well-known makes. In two instances the labor costs were excessive, as noted in the table, because the connections as shown on the manufacturer's blueprints were in error. The motors of 10 hp and larger were rewound with new coils, while those of 5 hp and less were reconnected. The grand total cost was $177.76 for ten motors with a combined rating of 78 hp, or $2.28 per hp.

LARGE HYDROELECTRIC DEVELOPMENTS OF THE NEW ZEALAND GOVERNMENT.

Lake Coleridge Power Station to Furnish Energy for Railway Service, Towing of Canalboats, Street Lighting and Various Industrial Purposes.

WORK has recently been commenced on the first of the hydroelectric power schemes of the New Zealand government to be put in hand under the water-power act of 1903. The provisions of this act vest the right to all water-power within the Dominion of New Zealand in the government and confer on the Minister of Public Works the necessary powers to construct and operate hydroelectric installations. After considerable discussion the government decided to carry out the development works itself in preference to leasing them, and the "aid to water-power" act of 1910 authorized the government to raise loans not exceeding $2,500,000 a year for five years for this purpose. A special branch of the Public Works Department was established to carry out the work and placed under the charge of Mr. E. Parry, assisted by Mr. L. Birks.

The first scheme to be put in hand is the Lake Coleridge installation for the supply of Christchurch and the Canterbury province. The headworks for this development are now in hand and specifications have been prepared and tenders invited for the necessary plant and equipment.

Lake Coleridge is situated in the Southern Alps and is distant about 70 miles to the west of Christchurch. Its surface is 1667 ft. above sea level. It is 10 miles long and 2½ miles wide with an area of 14 square miles. In spite of its altitude the lake does not freeze and its shores are entirely free from driftwood or other refuse. The outlet of the lake is at the western end, where the waters discharged from the lake, the Harper River and the Wilberforce River unite to join the Rakaia River further down. The latter river flows eastward parallel to the lake shore and separated from it by a ridge ranging from 1½ miles to 2½ miles wide, consisting of soft shale covered with glacial drift in a matrix of clay. The riverbeds have an average fall of 30 ft. to the mile, and from the lake outlet to a point in the Rakaia opposite the eastern end of the lake is 16 miles The gross head available at this point by piercing the separating ridge is 494 ft., the flood level in the Rakaia River being 1173 ft. above sea level.

The lake is fed by four streams, River Ryton, Scamander Creek, Simois Creek and Coleridge Creek, the total average outflow by the lake stream being about 160 cu. ft. per second. Owing to the enormous storage area of the lake the flow in the stream is very steady. The power available from the present outflow of the lake is thus 5000 kw for continuous working, or 10,000 kw on a 50 per cent load-factor. This is ample for the present purposes, but for future developments it can be increased by diverting the outflow of Lake Selfe into the Ryton River, by diverting the Acheron River into the lake, giving an additional average flow of 50 cu. ft. per second, by diverting a portion of the Harper River, with an average flow of 500 cu. ft. per second, into the lake, and by diverting a portion of the Wilberforce River into the lake. This is a very expensive work, but would give an additional supply of 1000 cu. ft. per second.

The effective storage area of the lake can also be increased by raising the level of the outlet by means of a dam. The ultimate capacity of the development can thus be increased as required to 50,000 kw for continuous operation or double this amount on a 50 per cent load-factor. The power available is thus ample for the probable demand in the Canterbury district for many years to come.

The water will be conveyed from the lake to the river bank by a tunnel 7260 ft. long. This tunnel will be semi-elliptic with a curved invert and will be 8 ft. high and 8 ft.

wide, with an area of 50 sq. ft. The maximum flow provided for is 270 cu. ft. per second. In order to provide for future developments the crown of the tunnel at the inlet will be 12 ft. below lake level, the tunnel being worked under this pressure. The grade will be 1 ft. in 1000 ft., giving a total fall of 7 ft. in the length of the tunnel. Headings are being driven to determine the nature of the ground. The lake end is in shale and the outlet end in hard shingle and clay. The entrance to the tunnel will be provided with duplicate gates and screening chambers so designed that the screens will be accessible at any time without cutting off the supply and that the pressure on the gates can be equalized before raising. The tunnel is provided at the outlet end with a surge chamber 30 ft. square and with gates and screens operated on the same principle as at the inlet. This arrangement entirely dispenses with costly mechanism and yet gives complete control of the flow in the tunnel. The surge chamber is designed in conjunction with the governors, flywheels and reactors of the generating sets so as to minimize as far as possible the disturbances arising from changes in the load and to enable the output to respond automatically to the requirements of the service.

In addition to the surge chamber at the tunnel outlet a depression in the surface of the ground midway along the tunnel permits of a shaft 195 ft. deep being sunk. This will be used to expedite construction by enabling two additional working forces to be obtained and will be lined with concrete for some distance above lake level. It will thus serve permanently as an additional surge chamber to assist in taking up the fluctuations of energy and adjusting the velocity of the water in the tunnel more rapidly to the exigencies of the service.

Provision is made in the power house for an ultimate equipment of six main generating units of 1500 kw rating each and two hydraulically driven and one motor-driven exciter unit of 150 kw rating. These will be supplied from the surge chamber by three penstocks 52 in. in internal diameter and half a mile long and ranging from ¼ to ⅝ in. in thickness. Each main penstock will branch at the lower end into two 30-in. pipes, each branch supplying one of the main turbines. The penstock pipes will be constructed of riveted plates in continuous lengths without expansion joints except at the exposed upper end. For the remainder of the length they will be laid underground with a cover of 2 ft. of earth to minimize the effects of change of atmospheric temperature. In order to prevent corrosion they will be thoroughly coated inside and outside with a high quality of bitumen compound 1/16 in. thick, and the outer surface will be further protected with a serving of Hessian laid on while the bitumen coating is still soft. The exciters will be supplied from a 15-in. bus pipe which will connect the three main penstocks at the lower end. In order further to equalize the flow in the main penstocks they will be connected in ordinary operation at their lower end by means of this bus pipe.

The main turbines will be of the Francis reaction type of 2150 bhp normal output and 2700 bhp overload capacity, and the exciter wheels will be of the Pelton type of 225 bhp normal output and 270 bhp overload capacity. The main generators will be three-phase alternators wound for 6600 volts and a frequency of 50 cycles. The motor for the motor-driven exciter will be a synchronous machine operated direct from the 6600-volt bus. In addition to the exciter generators a battery of fifty-six cells each of 800 amp-hr. rating will be installed to insure a supply of energy for excitation under any emergency which may arise.

The present installation will include two penstock pipes, three of the main generating units and one hydraulically driven exciter. The ultimate output of the complete plant of six units is based on the capacity of five units at rated load or four units at 25 per cent overload; that is, a maximum of 7500 kw. The output of the station will be controlled by a switchboard consisting of six main generator panels, two main transformer and feed panels, two synchronous motor panels and one center synchronizing and interconnecting panel.

All switches will be of the remote-control oil type placed in a gallery behind the switchboard, and provision is made by means of interconnecting switches for isolating the whole installation electrically into two independent systems, each supplying one of the duplicate banks of main transformers and transmission lines, thus reducing the risk of stoppage to a minimum. The exciter switchboard will be mounted with separate exciting and power-house-supply busbars with double-throw exciter generator and battery switches, thus allowing the exciting voltage to be regulated by means of a Tirrill regulator so as to compensate for the ohmic and reactive drop in the transmission line and insure a steady pressure at the main substation. The step-up transformers will consist of two banks each of three 1500-kw single-phase oil and water-cooled transformers, raising the pressure from 6600 volts to 66,000 volts for transmission. The transmission lines from the power station to the main substation at Christchurch, a distance of 70 miles, will consist of two independent pole lines, each carrying three conductors consisting either of seven No. 12 S. W. G. copper or seven 0.135-in. aluminum cables carried on four shell-pin insulators and spaced triangularly with 6 ft. between them.

At the Christchurch substation the pressure will be reduced by two banks of step-down transformers identical with the step-up transformers but star-connected on their secondary side to give 11,000 volts, three-phase, for the primary distribution. A branch of the 66,000-volt transmission line will also be run to Timaru—a flourishing seaport, 100 miles south of Christchurch—and ultimately in a northern direction also, with substations at intervals transforming down to 11,000 volts, at which pressure the energy will be distributed throughout the province. The energy will be supplied in bulk by means of underground cables to the Christchurch Tramway Board and the Christchurch City Council for retail distribution. It will also be distributed by means of overhead cables to the suburban boroughs, country towns and large meat works, woolen mills and the other industries established in the district as it is required.

It is estimated that a capital expenditure of about $1,875,000 will be required to install the full 9000-kw plant with distributing mains to all the main centers of population in the province. But only three out of the six units are included in the present installation. The estimates indicate that power will be available at $32 per horse-power per annum at the consumers' terminals.

Arrangements are being made for converting the portion of the railway between Lyttleton and Christchurch to electric working, the determining factor being the difficulty of ventilating the Lyttleton tunnel, and it is confidently anticipated that after gaining the experience of electric working on this section it will be extended to the main lines. A supply will also be required for the electric haulage through Arthur's Pass tunnel, now in course of construction. This tunnel, which will be 5 miles long, forms the connecting link of the Christchurch-Greymouth line between the east and west coasts of the South Island. With two tunnel sections operated electrically, it is probable that the remainder of the line will be converted in the early future.

A large and comprehensive scheme is now under consideration for the supply of electrical energy in the North Island, with the object of making it generally available to all the towns and districts throughout the island, and it is anticipated that advantage will be taken of the facilities offered to work the railways by electricity and to promote a system of light railways throughout the country districts now suffering from lack of communication because of the difficulty of obtaining stone for the purpose of surfacing the roads.

SAGS AND TENSIONS OF OVERHEAD CONDUCTORS.

Analytical Method for Determining the Mechanical Constants of Transmission Lines.

BY ALFRED STILL.

IN the *Electrical World* of Nov. 11, 1911, the writer described a graphical method for determining the sags and tensions at various temperatures of transmission line wires strung between rigid supports. This method, which involves the preparation of certain fundamental curves, is very rapid and accurate; but, in order to cover all materials and conditions, such as short, medium and extra-long spans, a number of charts would have to be prepared, and when such charts are not available an analytical method of calculating sags and tensions at different temperatures has advantages.

The methods of calculation usually employed are long and tedious, or they involve a certain amount of guesswork where cubic equations have to be solved. The purpose of the present article is to explain a rapid and accurate method of calculation by the aid of which sag-temperature curves can readily be plotted for any conductor material and length of span. The method requires the knowledge of the sag and tension corresponding to any particular temperature.

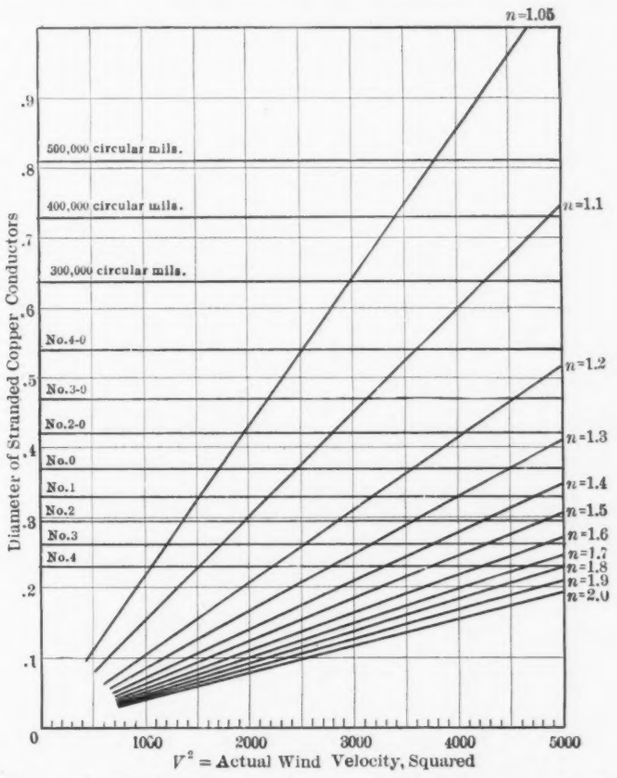


Fig. 1—Curves Showing Values of n Corresponding to Various Wind Velocities for Stranded Copper Conductors.

A different sag is then assumed, and the temperature at which this sag will occur is calculated by means of a simple formula. The manner of obtaining the preliminary data will be explained at the end of this article.

It is assumed that the conductor is strung between two fixed supports on the same level, and that the material of the conductor is not strained beyond the elastic limit. Use will be made, as usual, of the simple equations of the parabola. No error of any practical importance is introduced by assuming the curve of the wire to be a parabola instead of a catenary, even in the case of long spans with correspondingly large sags.

The meaning of the symbols used is as follows:

l = the length of span, or horizontal distance between points of support, in feet.

S = the vertical sag at center of span, in feet, when wire hangs in still air under the influence of its own weight only.

P = the tension in the conductor at the lowest point of span, in pounds.

T = the stress in the conductor at the lowest point of span, in pounds per square inch of cross-section.

L = the length of conductor measured between the two points of support.

t = temperature, in degrees Fahrenheit.

S_c, T_c, L_c = values of sag, stress and length corresponding to a definite temperature t_c.

a = the coefficient of linear expansion of the conductor per degree Fahr.

M = the modulus or coefficient of elasticity of the conductor, being the ratio of stress in pounds per square inch to extension per unit length.

w = the weight of conductor in pounds per foot of length.

W = the resultant or total load in pounds, per foot, including wind pressure and ice (if any).

n = a multiplier depending on the material of the conductor and weather conditions, being the ratio W/w.

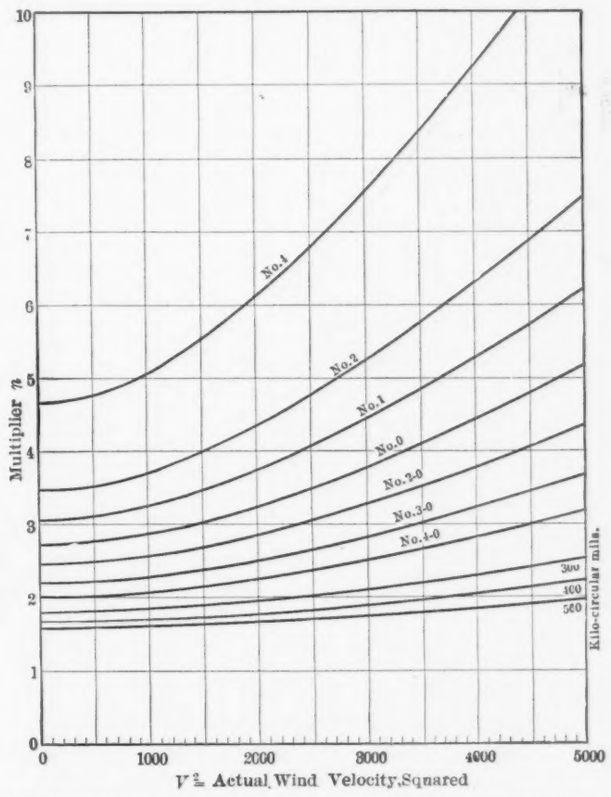


Fig. 2—Values of n for Similar Conductors with a Coating of Ice 0.5 In. Thick.

k = a constant depending upon the material of the conductor, being 1.5 times the weight in pounds of a cubic inch of the conductor material.

The well-known formula giving the relation between sag, length of span, horizontal load and tension is:

$$S = \frac{l^2 w}{8P} \qquad (1)$$

The approximate formula for the length of a parabolic curve (which is quite sufficiently accurate for all practical purposes) is:

$$L = l + \frac{8S^2}{3l} \qquad (2)$$

It is assumed that the sag S_c, and therefore the corresponding stress T_c and length L_c are known for the particular temperature t_c, which may be fairly high, so that another value, S, of the sag, arbitrarily chosen, shall be smaller than S_c; and it is proposed to calculate the temperature t which will correspond to this assumed sag, S.

With the reduction in the amount of sag, there must of necessity be a reduction in the length L_c of the conductor and an increase in the tension P_c or stress T_c. The amount by which the length has decreased is not directly proportional to the reduction in temperature, because the increase in tension causes an elastic elongation of the conductor, and the reduction in length is actually the difference between the amount by which the wire would contract with the lowering of the temperature if the tension were to remain constant, and the amount by which the wire would be extended, due to the increased tension, if the temperature were to remain constant; although, from a strictly scientific point of view, the argument may be inaccurate. The decrease in length due to temperature reduction is:

$$L_c \times a \times (t_c - t) \qquad (3)$$

and the increase in length due to additional tension is:

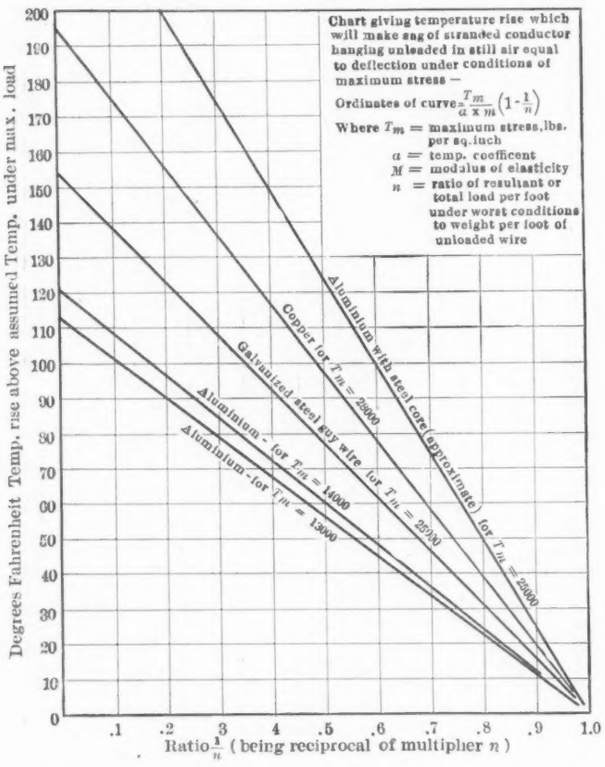


Chart giving temperature rise which will make sag of stranded conductor hanging unloaded in still air equal to deflection under conditions of maximum stress —
Ordinates of curve = $\frac{T_m}{a \times m}\left(1-\frac{1}{n}\right)$
Where T_m = maximum stress, lbs. per sq. inch
a = temp. coefficent
M = modulus of elasticity
n = ratio of resultant or total load per foot under worst conditions to weight per foot of unloaded wire
Aluminium with steel core (approximate) for T_m = 25000
Copper for T_m = 25000
Galvanized steel guy wire for T_m = 25000
Aluminium - for T_m = 14000
Aluminium - for T_m = 13000
Degrees Fahrenheit Temp. rise above assumed Temp. under max. load
Ratio $\frac{1}{n}$ (being reciprocal of multiplier n)

Fig. 3—Relations Between n and the Temperature Rise for Stranded Cables.

$$\frac{L_c}{M}\left(\frac{S_c}{S}\,T_c - T_c\right),$$

or

$$\frac{L_c}{M}\,T_c\left(\frac{S_c}{S} - 1\right) \qquad (4)$$

Therefore,

$$L_c - L = L_c \times a \times (t_c - t) - \frac{L_c}{M}\,T_c\left(\frac{S_c}{S} - 1\right)$$

The lengths L and L_c can be eliminated by substituting their values in terms of sag and length of span, as given by formula (2). This leads to the equation:

$$t_c - t = \frac{8S_c^2 - 8S^2}{(3l^2 + 8S_c^2) \times a} + \frac{T_c}{M \times a}\left(\frac{S_c}{S} - 1\right) \qquad (5)$$

This formula is very simple to use, because, for any particular material and size of wire, it can be written:

$$t_c - t = \frac{C_1 - 8S^2}{C_2} + C_3\left(\frac{S_c}{S} - 1\right) \qquad (6)$$

where C_1, C_2 and C_3 are constants, the values of which are:

$$C_1 = 8S_c^2 \qquad (7)$$

$$C_2 = (3l^2 + 8S_c^2)\,a \qquad (8)$$

$$C_3 = \frac{T_c}{M \times a} \qquad (9)$$

Moreover, since $8S_c^2$ is always very small in comparison with $3l^2$, the constant C_3 may, for nearly all practical purposes, be written:

$$C_3 = 3l^2 \times a \qquad (10)$$

This value for C_3 may be used for spans up to 500 ft. if multiplier n does not exceed 12, and for spans up to 1000 ft. if n does not exceed 6. In the case of larger spans, in which the sag is relatively large, or if a closer approximation is required, the more exact expression (8) should be used. The only unknown quantities in equations (5) or (6) being the sag S and temperature t, it follows that, by inserting any numerical value for S in the equation the change of temperature, and therefore the actual temperature t corresponding to the assumed value of the sag, can be readily calculated. In order that this method of calculation may be of practical utility, it is necessary that the sag S_c and the stress T_c at the particular temperature t_c shall be known. The fundamental data on which all line calculations are based must include the limiting or maximum allowable value of the stress and the conditions of maximum loading under the most severe weather conditions. The maximum load per foot being W and the weight of the unloaded wire being w, it follows that the ratio $\frac{W}{w} = n$ will be greater as the wind conditions, either without ice or combined with a coating of ice on the wires, are the more severe. The wires will generally be subject to the greatest stress at times when strong winds, with or without a coating of ice or sleet, occur at a low temperature, because the lowness of the temperature alone will account for a considerable increase in the tension.

Curves giving values of n corresponding to various wind velocities for aluminum conductors were reproduced in the article[1] previously referred to, and similar curves are here given which have reference to stranded copper conductors.

If the extra load on the wire due to wind and ice combined is great in proportion to the weight of the wire, the maximum deflection will usually occur under winter conditions; but there will be a higher temperature at which the sag of the unloaded wire hanging in still air, subject to only its own weight, will be exactly the same as the deflection under winter conditions when subject to wind pressure and extra load of ice, if the line runs through a district where sleet and ice formation is possible. This temperature, which may be called the critical temperature for the material of the conductor when the maximum winter loading has been determined, is easily calculated; and its numerical value, together with the known value of the sag under conditions of maximum load, and of the tension corresponding to this sag, may be used in equation (5) or (6) for the known quantities t_c, S_c and T_c.

CALCULATION OF CRITICAL TEMPERATURE t_c.

Let T_m be the limiting stress in the wire under the most severe conditions of load, and t_o the temperature at which this stress occurs. The tension T_c will be equal to T_m divided by n, because, at the critical temperature t_c, the sag is the same as the maximum deflection of the loaded conductor, but the weight per foot of length is in the ratio

[1] See page 1189 *Electrical World*, Nov. 11, 1911.

$\frac{w}{W}$ or $\frac{1}{n}$. Refer to formula (1), bearing in mind that, for any given size of conductor, the stress T is proportional to the tension P. With an increase of temperature from t_o to t_c the reduction in stress is

$$T_m - T_c = T_m - \frac{T_m}{n} = T_m \left(1 - \frac{1}{n}\right)$$

and the reduction in length of the wire due to this difference of tension is

$$\frac{L}{M} T_m \left(1 - \frac{1}{n}\right)$$

It is required to calculate the temperature rise $(t_c - t_o)$ which will produce an *extension* exactly equal to this elastic contraction, in order that the length L_c of the wire, and consequently the sag S_c, shall remain as before.

The extension due to temperature rise is

$$L_c \times a \times (t_c - t_o)$$

and the required equation is:

$$L_c \times a \times (t_c - t_o) = \frac{L_c}{M} T_m \left(1 - \frac{1}{n}\right)$$

or

$$(t_c - t_o) = \frac{T_m}{M \times a}\left(1 - \frac{1}{n}\right) \qquad (11)$$

The curves in Fig. 3 give the relation between the ratio $\frac{w}{W}$ (being the reciprocal of n) and the temperature rise $(t_c - t_o)$ for stranded cables of different materials. The values of M and a, which have been adopted for the purpose of drawing the diagram, are:

For hard-drawn copper, $M = 15 \times 10^6$, $a = 9.6 \times 10^{-6}$
For hard-drawn aluminum, $M = 9 \times 10^6$, $a = 1.28 \times 10^{-5}$
For galvanized steel, $M = 25 \times 10^6$, $a = 6.5 \times 10^{-6}$

Having determined the critical temperature t_c at which—it is interesting to note—the tension in the wires, if correctly strung will be the same whatever the length of span, the sag S_c can be calculated by the formula (1), or by the more convenient formula:

$$S_c = \frac{kl^2}{T_c} \qquad (12)$$

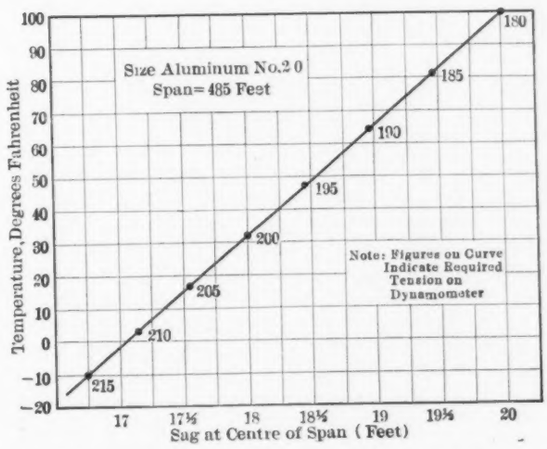


Fig. 4—Relations Between Temperature and Sag.

or

$$S_c = \frac{knl^2}{T_m} \qquad (13)$$

which can readily be deduced therefrom. In this manner the numerical values of the quantities t_c, S_c and T_c, for use in formula (5) or (6), are obtained.

Example:

Consider a span 485 ft. long, with rigid supports. Conductors of aluminum, size No. 2-0, B. & S. Maximum loading, 0.5-in. coating of ice, combined with a wind velocity of 47 miles per hour at a temperature $t_o = -20$ deg. Fahr.

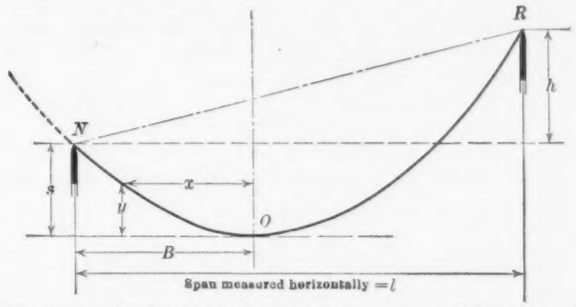


Fig. 5—Overhead Conductors with Supports at Different Levels.

$n = 8$ $\qquad \frac{1}{n} = 0.125$

$T_m = 14{,}000$ $\qquad k = 0.146$

$t_c - t_o = 106$ deg. (read off Fig. 3).

Hence

$t_c = 86$ deg.

$T_c = \frac{14{,}000}{8} = 1750$, and, by formula (12),

$$S_c = \frac{0.146 \times 485 \times 485}{1750} = 19.6 \text{ ft.}$$

By formula (7), $C_1 = 8 \times 19.6 \times 19.6 = 3070$

By formula (10), $C_2 = 3 \times 485 \times 485 \times 1.28 \times 10^{-5} = 9$

By formula (9), $C_3 = \frac{1750 \times 10^5}{9 \times 10^6 \times 1.28} = 15.2$

By formula (6), $(86 - t) = \frac{3070 - 8S^2}{9} + 15.2\left(\frac{19.6}{S} - 1\right)$

By choosing values for S not very different from S_c the corresponding temperatures are easily calculated. Thus

when $S = 16\frac{1}{2}$ ft., $t = -15.8$ deg. Fahr.
when $S = 17\frac{1}{2}$ ft., $t = +15.4$ deg. Fahr.
when $S = 18\frac{1}{2}$ ft., $t = +48.4$ deg. Fahr.
when $S = 20\frac{1}{2}$ ft., $t = +120$ deg. Fahr.

With the aid of these figures a curve such as Fig. 4 is readily plotted. This curve gives the men in the field all necessary information for the correct stringing of the conductors, whatever may be the temperature when the work is carried out.

SUPPORTS AT DIFFERENT LEVELS.

For any given horizontal tension in a suspended wire of a particular material, hanging between supports under the influence of only its own weight, there is a definite curve such as the parabola drawn in Fig. 5, which may be considered to extend indefinitely in both directions. The suspended wire may be secured to rigid supports at any two points, such as N and R, lying on this curve, without altering the tension in the wire. The law of the parabola is:

$$x^2 = Cy \qquad (14)$$

and in the case of a suspended wire the multiplier C will be directly proportional to the tension P, and inversely proportional to the density of the conductor material. The value of C in terms of the tension and weight of conductor is readily obtained by inserting for x and y the corresponding span and sag values as given by formulas (1) and (12). Thus

$$C = \frac{2P}{w} \qquad (15)$$

or

$$C = \frac{T}{4k} \qquad (16)$$

If S = sag below level of lower support,
B = horizontal distance of lowest point of wire from lower support,
h = difference in levels of the two supports,
l = length of span measured horizontally, all as indicated on Fig. 5, then, by inserting the required values in equation (14), the following equations are derived therefrom:

$$B^2 = C \times S,$$
$$(l-B)^2 = C\,(S+h),$$

or

$$l^2 + B^2 - 2\,l\,B = C\,S + C\,h,$$

from which B^2 on the one side and its equivalent $C\,S$ on the other side cancel out, leaving

$$l^2 - 2\,l\,B = C\,h.$$

Therefore

$$B = \frac{l^2 - C\,h}{2\,l} \qquad (17)$$

and

$$S = \frac{B^2}{C}. \qquad (18)$$

From an inspection of formula (17) it is seen that if $C\,h = l^2$, the lowest point of the wire coincides with the lower support N, while if $C\,h$ is greater than l^2 the distance B is

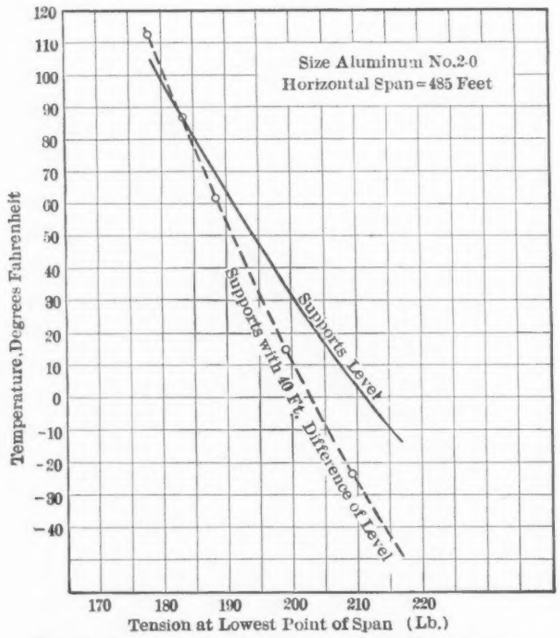


Fig. 6—Relation Between Tension and Temperature.

negative, and there may be a resultant upward pull on the lower insulator N, a point to bear in mind when considering an abrupt change in the grade of a transmission line.

The length of wire between the two supports N and R may be considered as the sum of two distinct portions of the parabolic curve $N\,O\,R$; the one $N\,O$, the length of which, according to formula (2), is

$$B + \frac{4\,S^2}{3 \times 2\,B}$$

and the other $O\,R$ of length

$$(l-B) + \frac{4\,(S+h)^2}{3 \times 2\,(l-B)}$$

The sum of these two quantities is

$$L = l + \frac{2}{3}\left[\frac{S^2}{B} + \frac{(S+h)^2}{(l-B)}\right] \qquad (19)$$

For the calculation of the sags and tensions at different temperatures, the formula (6) is no longer applicable; but the calculation can be proceeded with on the same general lines. An example will best illustrate the writer's method.

Example: Calculation of sags and tensions at different temperatures with supports not on the same level. All data and constants are assumed to be the same as in previous example, the horizontal length of span being 485 ft., as before, but there is a difference of levels between supports of $h = 40$ ft. Four numerical values of the stress T, other than the known value ($T_c = 1750$) at the critical temperature, have been arbitrarily chosen, and the corresponding temperature t has been determined in the manner indicated in the accompanying table.[2]

NUMERICAL VALUES OF STRESS.

Stress T, in pounds per square inch	1700	1750	1800	1900	2000
$C = T \div 4k$	2910	2990	3080	3250	3420
$B = \frac{l^2 - Ch}{2l}$	122.4	119.1	115.2	108.3	101.2
$S = B^2 \div C$	5.15	4.75	4.32	3.61	2.99
$L = l + \frac{2}{3}\left[\frac{S^2}{B} + \frac{(S+h)^2}{l-B}\right]$ = 485 +	3.89	3.77	3.66	3.45	3.27
$L - L_c$	+0.12	0	−0.11	−0.32	−0.50
Difference in length due to stress variation $= (T - T_c)\,L \div M$	−0.00272	0	+0.00272	+0.00816	+0.0136
Elongation due to change of temperature, being difference between total elongation and elongation due to stress variation	+0.1227	0	−0.1127	−0.3332	−0.5136
Difference of temperature necessary to cause the above elongation (degs. Fahr.) $t_c - t = \frac{\text{temperature elongation}}{a \times L}$	−26.2	0	+24.1	+71.3	+109.5
Actual temperature, t, being the "critical" temperature less the above differences	112.2	86	61.9	14.7	−23.5

The tension in the conductor is ascertained by multiplying the stress T by the cross-sectional area (in this example 0.1048 sq. in.), and the dotted line in Fig. 6 shows the relation between tension and temperature as calculated in the manner indicated by the above table of results. The full-line curve shows the relation as previously calculated for the same conductor and same horizontal span, but with supports on the same level. These curves do not coincide, and it is therefore not correct to make sag-temperature calculations for spans with supports at different levels, on the assumption of an equivalent span of the same length with supports on the same level.

USE OF BALANCER SET TO BRING UP LOW BATTERY CELLS.

A central station supplying energy to a 110-220-volt Edison three-wire system makes use of a pair of 50-kw machines coupled together, operating as a balancer set. The same station also contains a storage battery with a rating of 1200 amp-hr. To give low cells special charges without disconnecting them from the main battery operation, this pair of balancer machines proves very useful run as a motor-generator set. The machine used as a generator is carefully insulated from ground and all other parts of the system, and can be connected to a pair of No. 0 copper leads extending overhead the length of the battery-room. Jumpers with clip connectors are used to join this charging circuit to the terminals of the cell or cells to be treated, copper strips being clamped onto the lead webs to insure good contact. With this arrangement any cell or group of cells can be put through a cycle of charge without disturbing its connections or the operation of the main battery.

[2]The numerical values as given by the various formulas in this and the previous example have been worked out on the slide rule, and are approximate only.

Central Station
Management, Policies and Commercial Methods

CENTRAL-STATION STAFF MEETINGS.

Each Friday evening, beginning at 7:30 and lasting until 9:30, the heads of departments of the Marion (Ind.) Lighting & Heating Company get together for a staff meeting to talk over matters of common interest and co-operation. Special subjects are assigned at some of these meetings, but the discussion at all of them has been productive of excellent results, including some of the best ideas and "stunts" evolved in connection with the Marion system. Among the departures proposed at these meetings and afterward carried into actual practice were the use of gas-pipe cross-arms, digging of pole holes with dynamite, construction of a "Prestolite" search-lantern for linemen, flat-rate motor schedule operation indicator, improved routing of work orders, etc. Twelve to fifteen persons attend each Friday night session, and these "get-together" evenings are counted among the most valuable features of the local staff's work.

DIRECT ADVERTISING IN WICHITA HOUSE-WIRING CAMPAIGN.

During the last twelve months more than a thousand old houses in Wichita, Kan., a city of 60,000, have been wired as the result of an aggressive campaign. Efforts have not been relinquished even in the winter, and 75 to 100 contracts have been closed each month since December. Three solicitors are employed on this residence work. Each of these men works along with a salesman hired by one of the three local contractors co-operating with the company on its special wiring offer. Each team, composed of the contractor's and central station's salesmen, has assigned to it a district, and all orders obtained by either solicitor are awarded to that contractor. When the wiring is completed the company pays the contractor the cost of the work, being itself reimbursed in twelve monthly instalments, payable with the customer's lighting bills. To its own solicitors it offers a cash bonus of $25 for each 100 houses closed.

Effective use has been made of direct advertising in this campaign. Form letters, circulars, booklets and post cards are distributed by the solicitors in their house-to-house canvass, and in this way practically every local dwelling is reached several times a month. One of the most useful dodgers thus distributed has been a blank house-wiring contract, filled in with the contractor's name and address and all ready for the customer's signature. Included in the form is a statement of the three propositions offered, which are as follows:

"(a) Drop lamp complete with five drop cords, three ornamental glass shades and five incandescent lamps. This will supply lighting for parlor or living-room, dining-room, kitchen and two bedrooms. Total cost, $13.50.

"(b) Five openings, two having two-light fixtures, six ornamental glass shades, seven incandescent lamps. This installation will give two lamps in the living-room and dining-room and one in each of the others. Total cost, $16.50.

"(c) Five openings, brass tubing or oxidized fixtures, instead of drop cord. Two fixtures having two lamps each, the others one. Shades are richly ornamented. This gives a really artistic installation of seven lamps, the lamps being included in the price. Total cost, $23."

The second proposition, five outlets for $16.50, has of course proved to be the most popular, and at least 55 per cent of the contracts closed have been under this arrangement. The cost of soliciting and securing these house-wiring contracts, according to Mr. Malcolm A. Smith, sales agent for the Kansas Gas & Electric Company, has been less than $3 per house, including all outlay for solicitors' salaries, printed matter and advertising.

NEW CENTRAL-STATION OFFICE BUILDING AT SPRINGFIELD, MASS.

Description of a Notable Structure Establishing a High Standard of Office Practice and Illustrating Unusual Beauty of Architecture.

The United Electric Light Company, of Springfield, Mass., has recently completed a new office and headquarters building which may be said without exaggeration to be unsurpassed in architectural beauty and dignified utility by any central-station structure in the country. The building

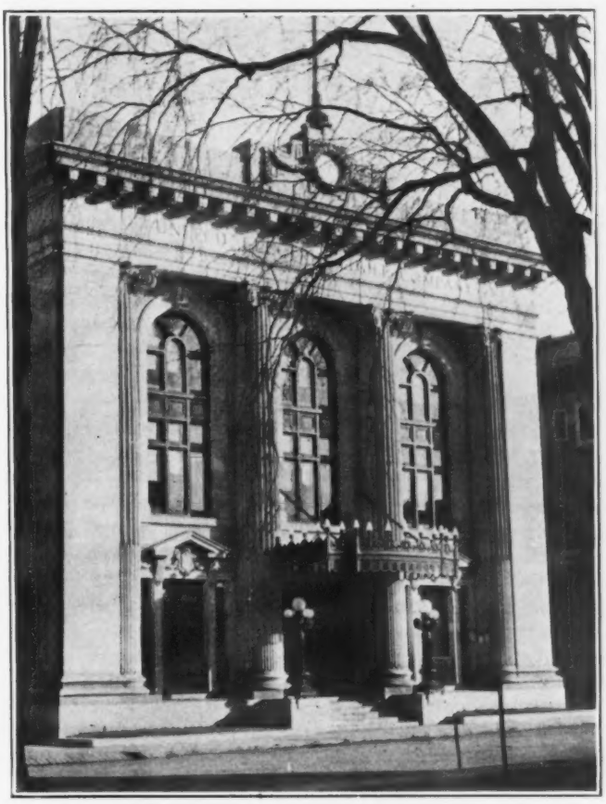


Fig. 1—Office Building of United Electric Light Company, Springfield, Mass.

was opened for business on March 1, the growth of the company's service during recent years making it necessary to remove from the offices formerly occupied into quarters capable of meeting the demands of many years. It is located near the celebrated "municipal group" of public structures in the heart of the city, and expresses the belief of the company that its new home should compare favorably with any mercantile or industrial establishment in the community. In architectural appearance it accords with the

most tasteful banking structures erected within recent years for metropolitan service, and it forms one of the artistic assets of the city as well as a commercial plant of efficient detail.

The new building is located on West State Street, near Main Street, and at present is a three-story and basement

Fig. 2—Main Entrance of Central-Station Office Building.

structure with a frontage of 60 ft., a depth of 76.5 ft. and a height of 64 ft. from the sidewalk to the top of the pediment. In the general design the object sought was to afford the public the maximum convenience of access to all departments. The exterior is of Bedford (Ind.) limestone, a Roman Renaissance treatment being given. The main façade is provided with fluted Ionic columns extending from the base to the main entablature. High arched windows, hand-carved copings and a handsome frieze give individuality to the façade without detracting from its simplicity. The columns at either end are flanked with wide pylons, and in the center above the main entablature is an ornamental cartouche, consisting of a heavy wreath and festoons of laurel on either side, with a piece of veined pavonazzo marble set into it. The cartouche serves also as a massive base for the flagpole, which is 35 ft. in height. The stone has a flush tone which gives the front a warm, attractive color. The main entrance, centrally located between the two principal columns, is protected by a glass and iron marquise, the details of which are ornamented in cast and wrought iron consistent with the column scheme in the façade. On either side of the entrance are placed massive candelabra resting on granite buttresses. The marquise is illuminated by twenty torches and is supported by heavy chains. A flight of granite stairs leads to the doorway from the street, and upon passing into the building the visitor comes into immediate touch with all departments. The side and rear walls are of buff brick, and on the east a concrete area with a drained floor has been provided for the use of motor and other vehicles delivering and transferring supplies and apparatus used in the company's service. The floors of the building are of reinforced concrete construction, the frame being of steel. The design provides for the addition of two stories to the present structure when needed.

Upon entering the vestibule the visitor encounters an information bureau and private branch telephone exchange, the office of the general manager being situated immediately at the right of the entrance. A short corridor similar in construction to the vestibule leads to an octagonal rotunda located in the center of the building, this arrangement being made to provide the easiest access to all departments and stairway openings. The rotunda opens up from the first floor through the second floor and into a dome in the third story, where an admirable supply of natural lighting is introduced into the heart of the interior. Knoxville marble with a yellow Sienna border is used in the floors of the vestibule and rotunda. The wainscoting serves as a practical counter material, opening into the cashier's and other departments. A balcony at the second floor is guarded by a balustrade of ornamental wrought iron with a mahogany hand rail. The eight openings to the departments from the rotunda are guarded by eight pilasters with ornamental caps, and the whole design of the interior illustrates a rich simplicity, the walls being plastered and treated in soft shades of gray. The second corridor walls of the rotunda are carried in lighter shades of gray as they approach the dome in the center, the latter being of art glass done in conventional designs in amber and green. The white background for the design is of silver ripple glass. In the center of the rotunda is a marble table on an octagonal pedestal and molded base.

Hanging from the center of the dome and suspended about 28 ft. is an alabaster vase 30 in. in diameter and 36 in. high, containing four 60-watt lamps. The vase was carved in Florence, Italy, and features four cartouches designed with the monogram of the company in each. It is suspended by four bronze chains and is the largest piece of alabaster imported into the United States to the present time. Midway between the vase and the eye of the dome is a secondary piece of alabaster forming a crown and containing four 40-watt lamps for the illumination of the rotunda at the second-floor level. In addition to this

Fig. 3—Interior View of Office.

central feature there are other alabaster pieces of a simpler nature placed in the paneled soffit at the second-story level, one piece being designed for each of the eight panels.

The first floor contains the rotunda, diameter 24 ft.; general manager's office, 18 ft. square; a display room, 18 x 27 ft.; accounting room, 42 x 22 ft.; and meter and

lamp renewal department, 22 x 32 ft., in principal dimensions. Quarters are also provided for the assistant manager, and among the other features of the floor are a 6.5 x 10-ft. fireproof vault, elevator and stairway connections to other parts of the building. The floors in the foregoing departments are of cork carpet, cemented with waterproof material directly upon the concrete floor of the building. The general manager's office is finished in flat panels of selected mottled grained Mexican mahogany. The exhibition room is lighted by eight 100-watt tungsten lamps installed about 10 ft. above the floor, and the meter department and lamp division is equipped with indirect lighting by seven 100-watt units installed 10 ft. above the floor. Electric service outlets are provided at many points in the exhibition room and elsewhere on the street floor and all wiring is run in conduit, the center of distribution for the building being at a main switchboard in the basement. Private lavatories are installed on the street floor for the manager and staff, and a lavatory for women employees is located in the basement, this being connected with the general offices by a private stairway forming the only means of entrance or exit.

The second floor is devoted to an executive suite, including president's office, reception room and directors' room at the front, chief draftsman's office, drafting room, employees' clubroom and several small offices. The executive suite is furnished in the same general style as the manager's office, the president's office and board room being 18.5 ft. square each. The drafting room, 23 x 34.5 ft., is provided with daylight illumination on the south and west sides and is equipped with nine 60-watt tungsten lamps for night service. A fireproof vault with metal filing equipment is located at one end and the company has recently completed an exhaustive tabulation and inventory of all its poles and underground structures, which are shown on index cards in detailed drawings covering every item on the system. A third vault is located in the basement, directly below the others, and in cleaning out a large number of old books and papers the company recently found that the work could be done with great economy by the use of an ozonizer. The employees' club room, 18 x 31 ft., is furnished with reading and card tables, a stage, private lavatory and a separate entrance from the rear of the building as well as an inside entrance from the rotunda second-floor corridor, and it is open day and night for the use of the company's men. Hat and coat hooks are provided on the walls at each side of the private stairway. Lectures on electric cooking are given in this room at intervals, as well as entertainments and other evening attractions. Electrically prepared luncheons are also given here on occasion. The third floor is at present used for storage purposes only. The executive suite on the second floor is entirely separate from the rest of the building and is equipped with private lavatories, bracket lamps and small alabaster lighting fixtures for overhead service.

The basement is devoted to locker accommodations, a boiler room, air-washing system, meter and arc lamp storage divisions, meter laboratory, elevator machine room and a switchboard section. All the electricity used in the building is controlled at a three-panel slate switchboard in the center of the basement, containing a main switch, fuses and knife switches for distribution feeders on the premises. The services brought into the building are 440 volts, two-phase, 500 volts direct-current and 220 volts, three-wire single phase, all the alternating-current supply being at 60 cycles. Watt-hour meters are installed on the three panels. The entire building is served by a 1000-lb. Otis electric elevator of the automatic push-button control type. The elevator motor, rated at 10 hp, is located in a concrete pit in the basement and is supplied with two-phase energy. Wired-glass doors are provided at the side of the well.

The meter laboratory is equipped with a four-panel switchboard for testing instruments and meters, this being mounted on a concrete floor coated with cement paint, the panels being braced by five 1.25 x ⅜-in. rods inclined into the floor. A testing shelf or table 18 in. wide and 11 ft. long is located at the base of the panels and about 3.5 ft. above the floor. A rubber mat in front of the table protects the laboratory staff from grounds. Polyphase meters under test are hung against the panels by studs, and three brass racks with sliding adjustments are provided for testing Thomson watt-hour meters. The testing board is provided with 440-volt, two-phase, 110-volt, single-phase, and 500-volt direct-current outlets. The board is 3 ft. high, and is wired to lamp-bank and water rheostat loads located in a separate room in the basement, the water rheostat adjustment being made by a rope and pulley installation with a 16-ft. action. An instrument cabinet for the reception of standards is located in the laboratory, and portable testing instruments are kept here. Westinghouse precision type primary standards are used by the company. The connected maximum load of the 110-volt, single-phase panels is 200 amp each, the direct-current load having a maximum capacity of 100 amp. The lamp and water rheostat vault, 9 x 13 x 10 ft. in dimensions, is an interesting feature of the

Fig. 4—Alabaster Vase in Rotunda.

building. The room is provided with fireproof walls and a window affording a good supply of natural light. The lamp resistors consist of groups of carbon lamps of various sizes mounted on iron racks made of 1 x ⅛-in. rods, with 1 x ¼-in. crosspieces, the whole forming a grillwork supported on 2300-volt line insulators bolted into the walls. Each lamp circuit is fused. The 110-volt banks contain 260 lamps of from 2-cp to 50-cp rating, and the 500-volt rack contains forty lamps of from 0.5 to 2.5 amp rating. The window is fitted with wired-glass panes. The water rheostat consists of a hogshead fitted with a faucet supply and drained to the sewer through a trap, with the usual adjustable contact plates.

The storage facilities of the basement include twenty-four metal lockers with ventilated tops and bottoms, the lower portions being carried well above the floor line; shelves for meter and shade storage, with classification according to the sizes and types of equipment; arc lamp storage, covering facilities for about 100 arcs in an overhead aisle space 25 ft. long, the lamps being hung from two 2-in. iron conduits; a stock cabinet for electric heating appliances, and shelves for incandescent lamp storage, the company having found that more lamps can be kept in a given space out of the boxes. A space has also been set

aside for arc-lamp testing and the coloring of incandescent bulbs, the final drying being effected by placing the lamps in circuit. The basement also contains a photometric laboratory equipped with a Queen photometer, a 500-to-110-volt direct-current motor-generator set, and a motor-driven test lamp making 180 r.p.m.

The heating of the building is taken care of by a Bigelow steam boiler, a small hot-water heater being in service for warm weather. Ashes are hoisted to the street by block and tackle, and anthracite coal is burned. A ventilating system is provided by which air drawn from without the building is passed through a spray chamber served by a 2-hp motor-driven pump, and thence delivered by ducts to the various rooms. The supply of air for the rotunda is delivered through grillwork located beneath the counter of the central marble standard, and a 36-in. motor-driven exhaust fan located in the top of the rotunda discharges vitiated air into the atmosphere at the top of the building. The employees' club room is also fitted with exhaust fans driven by motors. The temperature is automatically controlled by the Johnson system of heat regulation.

"Alba" shades are extensively used in the building in connection with the illumination of various departments, and the torches on the marquise are equipped with 60-watt tungsten lamps. The standards at the entrance are equipped with one 250-watt and five 100-watt lamps in each case, and at the roof of the building a large electric sign has been erected displaying the company's name on a liberal scale.

The architect of the building was Mr. Thomas M. James, Boston, Mass., and the officers of the company are: President, Robert W. Day; treasurer, W. A. Lincoln; general manager, Walter L. Mulligan, all of Springfield.

Wiring and Illumination

VOLTAGE DROP IN SINGLE-CONDUCTOR, STEEL-TAPED CABLE.

By J. R. Cravath.

It has long been known that the use of alternating-current conductors in iron pipes is not usually feasible where only one conductor is placed within the pipe. The pipe forms a closed magnetic circuit and the reactance caused by the presence of this magnetic circuit around the wire causes such a large drop in voltage that the arrangement is not feasible. With heavy currents there is also some hysteresis loss in the iron which results in the heating of the iron pipe and an actual loss of energy as an additional undesirable feature.

Of late the question has frequently come up in practice whether single-conductor, steel-taped, lead-covered cable would be feasible for series alternating-current circuits supplying tungsten lamps. Where such cables can be buried in a parkway under sod, where they can be easily got at or replaced in case of trouble, such a construction would offer a very substantial and satisfactory means of supplying series tungsten lamps from underground circuits at a much lower cost of underground work than any of the common forms of underground conduit construction. The use of steel-taped, single-conductor cable for this purpose might seem at first thought similar to the use of a continuous iron pipe around a wire. Several well-posted engineers have stated offhand that the use of steel-taped, single-conductor cable on a series alternating-current street-lighting circuit is impracticable. So did the writer before investigation. Definite figures on the performance of steel-taped, single-conductor cable under such conditions seem to be lacking.

As it recently became of importance for the writer to know the voltage drop per 1000 ft. with such cable under working conditions on a series street-lighting circuit, a test was arranged for on a length of such cable in service at Charles City, Ia., through the courtesy of Mr. A. L. Dodd, manager of the Charles City Light & Heat Company. The length of cable in this circuit is approximately 6900 ft. It is laid in dirt and serves twenty ornamental lamp-posts in a residence district.

The test was made by short-circuiting the lamp receptacles by removing the series lamp sockets and then passing the normal 6.6-amp operating current through the circuit with a voltmeter across the terminals of the underground loop in question. This underground loop is part of a street-lighting circuit which includes some overhead lines, and the underground loop of this circuit returns to the same pole from which it starts, so that voltmeter connections were easy.

It was found that the total voltage drop per 1000 ft. of steel-taped underground cable operated 60 cycles at 6.6 amp was 6.07. Of this drop probably about 2.6 volts to 2.71 volts was due to the ohmic resistance of the cable, the remainder of the drop being caused by the reactance. This cable was solid-conductor No. 6 insulated for 3500 volts working pressure, the diameter over the lead sheath being 5/8 in. and the diameter over all being 1 1-16 in. The armoring consisted of two layers of steel tape wound spirally in opposite directions.

It will be seen from the foregoing that the use of such cable is entirely feasible, as this drop is well within the limits of commercial practicability. It is to be anticipated that there will be extensive use of such single-conductor cable supplying tungsten lamps in residence districts the next few years, because it offers a cheap means of underground construction by burying the cable directly in the parkway 12 in. to 15 in. below the surface. The introduction of a series tungsten lamp for street-lighting purposes, offering a cheap source of light, together with steel-taped cable, offering a cheap method of construction, and the increasing amount of light which is being used on down-town streets will all have a very stimulating influence on better electric lighting in residence districts, and will make feasible the use of small lamps at frequent intervals, supplied underground, thus competing more strongly than ever with gas.

LIGHTING OF THE UNDERGROUND RAILWAYS OF LONDON.

In a paper read before the Illuminating Engineering Society in London Mr. Haydn T. Harrison described the methods employed in lighting the platforms and yards of the Underground Railways of London. Besides making some valuable general recommendations on the subject Mr. Harrison attempted to specify the order of illumination required for various classes of stations, giving a series of data on the subject which is printed on the following page.

These figures were based on a large number of tests made by Mr. Harrison on the railways of Great Britain, and he also recalled the suggestion of Mr. Roger T. Smith that a minimum horizontal illumination of 0.25 ft.-candle might well be allowed on important stations. Another part of Mr. Harrison's paper was devoted to the respective fields of usefulness of powerful high candle-power units and of more closely spaced units of moderate candle-power. He expressed the view that for yards and large open spaces generally flame-arc lamps and high-pressure gas lamps are well suited; for platforms very favorable results can be secured by spacing fairly near together and at a moderate height incandescent electric lamps and low-pressure gas units, the design of an appropriate reflector being, however, a very essential factor. At the end of his paper Mr. Harrison referred to the report of the committee of the

Association of Railway Electrical Engineers in Chicago, an abstract of which appeared in the *Electrical World* for Dec. 2, 1911. It is very interesting to notice that the recommendations in the two cases agree very closely in some

ANALYSIS OF EQUIPMENT AND ILLUMINATION.

Test Lines.	Class of Station.	Type of Lamps in Use.	Average Minimum Horizontal Illumination, Foot-candles.
1	Large main line station	Low-pressure gas upright mantles	0.015
2	Large main line station	High-pressure gas	0.07
3	Large main line station	High-pressure gas	0.12
4	Main line terminus	High-pressure gas	0.20
5	Main line terminus	Flame-arc lamps	0.50
6	Main line terminus	Flame-arc lamps	0.25
7	Main line terminus	Flame-arc lamps with special globes	1.26
8	Main line terminus	Ordinary open arcs	0.08
9	Main line terminus	Tungsten lamps	1.25
10	Main line station	Tungsten lamps	0.05
11	Main line large junction	Inverted gas	0.10
12	Suburban station (average)	Upright mantles	0.05
13	Underground tube stations	Inclosed arc lamps	0.24
14	Underground tube stations	Tungsten lamps	0.38
15	Underground tube stations	Tungsten lamps	0.18
16	Underground tube stations	Tungsten lamps	0.28

respects, although appearing quite independently about the same time.

In the discussion of this paper a number of prominent engineers connected with British railways took part, some exceptionally interesting data being presented relating to the "tube" railways in London, on which, of course, somewhat special conditions as regards lighting prevail. Mr. J. S. Dow presented a series of tests and photographs (the latter taken by Mr. V. H. Mackinney) on this subject, and it is clear that on these underground railways in London a good deal of experiment is going on.

The first of these tube-railways to be opened in London was the City & South London and some very interesting particulars were given showing how the standard of illumination has increased during the last twenty years. For example, at the Oval station the average horizontal platform illumination in 1896 was probably little more than 0.1 ft.-candle and the minimum probably less than half this amount. Yet the illumination at that time was considered exceedingly brilliant by the press and the public. Nowadays the minimum illumination on tube platforms rarely falls below 0.25 ft.-candle, thus confirming Mr. Harrison's figure.

One of the most interesting installations described in this account is that at the British Museum station on the Central London Railway, where use is made of 100-watt tungsten lamps and prismatic reflectors, at a height of 10 ft. and 24 ft. apart. A test at this station shows an average illumination of 1.2 ft.-candles and a minimum between the lamps of just over 1 ft.-candle. This high uniform value was obtained with only about 0.4 watt per square foot of platform illuminated. A view of this station is reproduced in Fig. 2.

Some other interesting installations have been made on the Underground Railways (comprising several different tube railways). For example, Fig. 3 shows an arrangement with indirect opal units at the top of the moving staircase at Earl's Court. It will be seen that the lighting is accomplished by means of opal inverted units and tungsten lamps and the effect is said to be very soft and pleasing to the eye. The consumption of electricity required for this area is stated to be only about 0.5 watt per square foot and the illumination is well over 1 ft.-candle in all parts. It is particularly necessary to avoid any glare at this point, as passengers proceeding to the moving staircase in the back of the picture would possibly be inclined to stumble if they were dazzled in this way. The authorities were anxious to make the process of stepping on and off the staircase a simple and familiar one, and the readiness with which the public has become accustomed to the method is ascribed partly to the ingenious method of lighting adopted.

The method of lighting is interesting. Panes of obscured glass are let into the sloping ceiling horizontally and tungsten lamps are placed above them. Looking up the stairs, as in the photograph, one can see these luminous diffusing glass plates, but the light is quite soft and does not offend

Fig. 1—Lighting with Concealed Lamps.

Fig. 2—100-Watt Tungsten Lamps in London Subway Station.

the eye. Looking down the stairs, on the other hand, it is impossible owing to the slope for the passenger to see the luminous glass at all; he sees only the brightly lighted stairs. It is thus impossible for him to be dazzled by the sources of light, and it is to be noted that it is in the case of people descending a stair of this kind that stumbling is most apt to occur, and would be most likely to have inconvenient results if it happened. Consequently the lighting has been planned specially with a view to the convenience of descending passengers, although, as stated, the effect even for ascending passengers is quite soft and satisfactory.

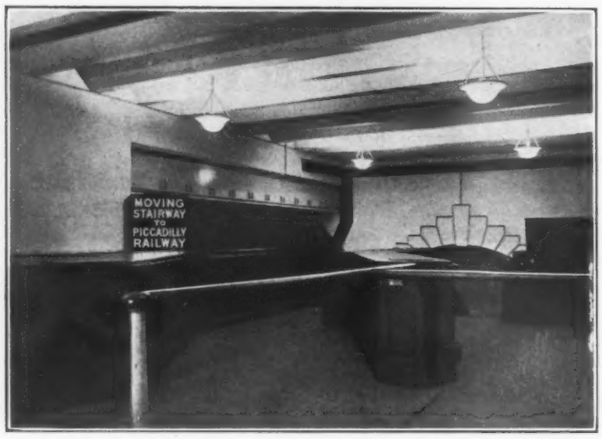


Fig. 3—Indirect Illumination in London Subway Station.

Fig. 1 shows the application of a similar method on some of the subways of the newest tube stations. The lamps are concealed in whitewashed slots in the ceiling, which is also white, so that the passengers are unable to see the filaments of the lamps. The method is interesting as showing co-operation between those concerned with the structural arrangements and those engaged on the lighting, just as in the case of the moving stairway mentioned above. This is the kind of co-operation one would like to see on the part of architects and lighting engineers, as it is naturally possible to secure exceptionally satisfactory effects by planning the building and the lighting together. The method shown is being adopted on the subways of the newest stations on the Underground Railways, which can be planned beforehand.

Fig. 4—Illumination of Moving Staircase.

In the case of existing passages which have no slots in the ceilings it is not of course possible to do quite the same thing. Even in these cases, however, a method has been adopted of putting up extra screens to keep the light from the filaments out of the eyes of passengers and to minimize glare. It is, indeed, striking to see how the elimination of glare is now taking as prominent a position in the minds of lighting engineers as the provision of a sufficiently bright illumination. The latest examples on these underground railways show a marked advance in this direction, although on some of the least enterprising railways much still remains to be done.

Letter to the Editor

THE ELECTRIC DRIVE.

To the Editors of Electrical World:

Sirs:—I note in the issue of March 2, page 480, in an article on comparative costs of shaft, group and individual drive in a shirt factory, a table giving larger aggregate horse-power in motors for shaft or group drive than for individual drive. This is unusual, as individual motors have to be able to take care of the maximum load on the machine, while with a number of machines on one motor it is highly improbable that each of the machines is doing maximum work at the same instant, and the motor therefore would be invariably of lower horse-power than the aggregate horse-power of the motors required for the individual drives. This ratio of the horse-power actually used and the aggregate horse-power of the motors on the installation is known as the "load-factor."

Not being familiar with shirt-factory machinery, I cannot make any estimate of the load-factor in this case, although from the figures given in the table it was apparently based on 100 per cent. As an illustration of load-factor on other classes of work, I give below figures from tests which I have made on machine-shop and woodworking tools individually driven.

Machine shop, 309 motors, load-factor 15.2 per cent; woodworking shop, 68 motors, load-factor 17.6 per cent. Recording instruments were used in all tests and the data are based on the highest peak load noted during observation of three or four days.

Again referring to the article, the annual kilowatt consumption is given as 42,600. This gives an average load of 15.2 kw based on fifty-two weeks of fifty-four hours each, or about two-thirds load on the motors. Friction load is given as 9.7 kw, this being about 63 per cent of the power consumed. Similarly, on the five-motor grouping, the total load is 8.7 kw, and as the friction load is 5 kw, 3.7 kw is left for productive work.

The table for individual drive gives 22,700 kw annually, which on above basis gives an average load of 8 kw. This appears to be exaggerated, as the same work is being done with 3.7 kw on the five-motor group.

I should be interested to know if the figures given in the table for these drives, especially the individual, were taken from actual tests.

West Lynn, Mass. G. E. Sanford.

[The figures contained in the article referred to were taken from a paper which was read by Mr. Egbert Douglas before the Milwaukee Engineering Society and the Milwaukee Section of the American Institute of Electrical Engineers. The figures were not intended to be taken as a specific case of showing which drive would be the most advantageous. The data were given to show the principal elements that should be taken into consideration in analyzing the two propositions to determine which would be the more economical. They were presented as an illustration to show the various elements that should be considered in comparing propositions of this nature. It should be added in this connection that the long-hour continuous use of all machines in a shirt factory might give it a higher load-factor and lower diversity-factor than an ordinary industrial establishment, in which case a larger horse-power in motors would be needed in group drives to overcome heavy friction load.—Eds.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Commercial Testing of Three-Phase Induction Motors.—A. J. MAKOWER AND P. A. MOSSAY.—The first part of an illustrated article in which the authors give results of measurements showing the extent to which the figures obtained for the power-factor, resistance, reactance and efficiency of three-phase induction motors vary with the method of testing and with the method of calculating from test results. In order to avoid misunderstandings it is suggested that a standard method of testing and of calculating should be adopted.—London *Electrician*, April 19, 1912.

Commutation.—W. WEILER.—A mathematical article illustrated by diagrams in which the author gives some simple formulas which permit the approximate calculation of the emfs which determine the quality of commutation in direct-current machines.—*Elek. u. Masch.* (Vienna), April 21, 1912.

Lamps and Lighting.

Arc-Lamp Electrodes.—W. VIEWEGER.—In view of the great expense for arc-lamp electrodes, especially with the tax levied on them in Germany, it is very important to consume them as completely as possible. The author explains how this can be done if some lamps are lighted the whole night and others only half the night by properly arranging the electrodes so that they are first used in the all-night lamps and the remnants are used afterward in the half-night lamps. He thinks that for new street-lighting systems it will be preferable to use high-candle-power metallic-filament lamps.—*Elek. Zeit.*, April 18, 1912.

Arc Lamps.—The first part of an illustrated article based chiefly on German patent specifications concerning recent progress in the construction of arc lamps with the electrodes arranged side by side in an inclined and nearly vertical direction. The methods used for supporting the electrodes and pushing them ahead when consumed are described.—*Zeit. f. Beleucht*, April 20, 1912.

Generation, Transmission and Distribution.

Weight Efficiency of Electric Motors and Prime Movers.—W. B. HIRD.—A paper read before the Newcastle Section

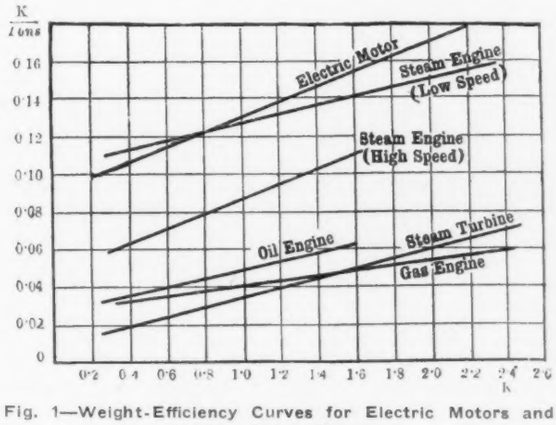


Fig. 1—Weight-Efficiency Curves for Electric Motors and Various Prime Movers.

of the (British) Institution of Electrical Engineers. The author compares the weight efficiencies of different types of motors and of different types of prime movers. He proposed to take as a basis of comparison the horse-power divided by the speed, this fraction being the same, or approximately the same, for any individual machine; then, taking any line of motors, a graph can be plotted of weights against this fraction, which is represented by the symbol K and may be called the output constant. If the constant K is divided by the weight in tons and a graph of the results plotted to base K, the graph will show what output in brake-horse-power per revolution is being obtained from

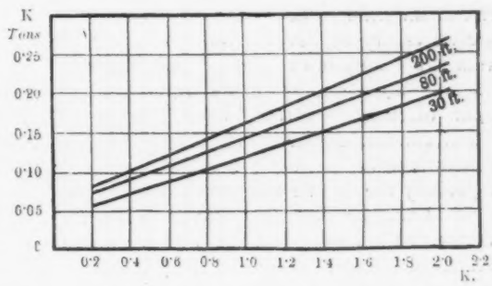


Fig. 2—Weight-Efficiency Curves for Water Turbines.

each ton of material used, and it is found that in a large number of cases the points thus obtained for one line of machines lie very nearly in a straight line. For simplicity's sake, all the curves are represented by a series of straight-line graphs showing the average result for each type of prime movers. Fig. 1 embodies the principal results obtained, but as in the case of the water turbine the slope of the weight efficiency curve was so much steeper than for the other engines investigated that a different scale was required, the water-turbine graphs are therefore given in Fig. 2. All these lines have the same general characteristics. They slope upward from left to right; that is to say, as one passes upward from the smaller to the larger members of any lines of machines, the weight efficiency goes up and a larger value of horse-power per revolution is obtained for each ton of material used. No great accuracy can, of course, be obtained in such a comparison, and many instances of individual motors occur the weight of which differs materially from that indicated by the average line for their type. The results obtained by these comparisons are discussed in some detail.—London *Electrician*, April 19, 1912.

Power from Peat.—C. HEINZ.—An illustrated description of a peat gas producer and a peat gas engine exhibited at the Posen Exhibition in Germany last year. The highest percentage of moisture in peat gasified was 50 per cent. The fuel consumption per hp-hr. was 2.2 lb. (1 kg.) of peat.—*Metall. and Chem. Eng'ing*, May, 1912.

Traction.

Berlin.—An illustrated article on the proposed electrification of the Berlin city and suburban railways ("Stadt-, Ring- und Vorortbahnen"). It is proposed to use single-phase current with a frequency of 16⅔ cycles and 15,000 volts on the trolley wire and electric locomotives. The only reason why locomotives are recommended is the desire to make use of the existing passenger cars. Otherwise the use of motor cars would have been preferable.—*Elek. Zeit.*, April 18, 1912.

Installations, Systems and Appliances.

German Electrical Industry.—A continuation of the long statistical serial on the condition of the German electrical industries in 1911. D. Bercovitz discusses measuring instruments and methods. Feussner's compensation apparatus, which permits a very high accuracy in direct-cur-

rent measurements, has been simplified in form and made more convenient for use, and its applicability has been extended. Further endeavors have been made to make the Deprez galvanometer suitable for alternating-current measurements, but the success has so far been slight. On the other hand, the quadrant electrometer has been considerably simplified by the Reichsanstalt and is being used now also for power measurements and transformer tests. For high-tension engineering static voltmeters are being used up to 200,000 volts and the Duddell oscillograph is being used in networks up to 50,000 volts. The metallic-filament lamp has affected the construction of meters in two directions since the sensibility of the meters had to be raised and their power consumption to be reduced considerably, and since it became necessary to develop much cheaper designs. This explains why amp-hour meters and mercury electricity meters are now finding some favor in Germany. P. Humann discusses overhead-wire line construction and cable and conduit construction, also the progress made in cable manufacture. A. Steinhaus discusses electric lighting and especially the ductile tungsten filament. He emphasizes that central stations should endeavor to make the consumer familiar with the idea that a 25-cp or 32-cp lamp is the new unit standard instead of the old 16-cp lamp. To do this, it would be well if the specific consumption of the 25-cp and 32-cp lamps was still further reduced. Metallic-filament lamps of 1000 cp are now being made with a specific consumption of 0.8 watt per cp with an average life of 1000 hours. These high candle-power metallic-filament lamps have become strong competitors of arc lamps, which are now being limited more and more to ratings of from 2000 cp or 3000 cp upward. Further progress in arc-lamp construction is hardly to be expected from mechanical improvements, but only from progress in electrode construction. A. Steinhardt discusses electric heating and cooking and B. Thierbach the use of electric motors for agricultural purposes and in factories and industrial plants in general.—*Elek. Zeit.*, April 18, 1912.

Municipal and Corporation Control of Central Stations in Germany.—A note stating that it has been observed recently that the electricity works built by town and cities in Germany have a tendency after a short time to get into the hands of the leading electricity companies. The Saxon Minister of the Interior has issued an enactment with a view to counteracting this tendency. It is stated in this publication that if it continues unchecked there is a great danger that in a short time the entire country will become dependent on a few gigantic concerns for the supply of electric energy. Such an eventuality would naturally bring with it a rise in the price of electric energy which would have an adverse effect upon industry in general. The Minister, therefore, urges the municipalities in strong terms not to be guided by temporary financial difficulties, for if once the electricity works go out of their hands the right which they have hitherto possessed of fixing the conditions for the supply of current will be irrevocably lost. He also points out that if in the first few years of the existence of a municipal electricity station the expenditure exceeds the receipts it is no reason for selling the works to a private company, as there are many municipal undertakings at the present day giving a good profit which had in the first few years to encounter financial losses. It is pointed out in the press that the reasons given by the Saxon minister apply equally to the lease of public works to private companies, because after the lapse of a number of years it has rarely been found possible for the municipality to take over the works again.—London *Electrician*, April 19, 1912.

Short-Circuit Power.—G. J. Meyer.—In the standardization of apparatus for high-tension alternating current plants it became necessary to define the power which passes through a certain apparatus under discussion in case of a short-circuit and which is to be interrupted, for instance, by an oil switch. The author explains the calculation of the short-circuit power and gives a formula which eliminates an inaccuracy in the former standardization rules. The author gives a number of examples which illustrate how in special cases the short-circuit power can be calculated.—*Elek. Zeit.*, April 18, 1912.

Electric Heating.—K. Pflugel.—An article discussing the introduction of electric heating apparatus into practice and recommending on the one hand inexpensive and robust constructions of the heating apparatus and on the other hand special and popular tariffs.—*Elek. Zeit.*, April 18, 1912.

Electrophysics and Magnetism.

Selenium and Light.—F. C. Brown.—The author has formerly shown that the changes of conductivity in a certain variety of selenium could be explained quite accurately by assuming that the light penetrates throughout the conducting layer and that it produces two changes in the selenium. If, therefore, the light action takes place in only a very small portion of the conducting layer, it might be necessary to recheck theory and experiment. The author has, therefore, investigated the effective depth of penetration. The chief results of the investigation are as follows: The effective depth of penetration of the selenium in the Giltay cell by light is about one-eighth of the thickness of the selenium. The entire amount of the selenium on the Giltay cell is conducting and light-sensitive. The effective depth of penetration is about 0.014 mm. The effective depth may be very much greater than the greatest depth reached by the light. The effect of filing or sand-blasting the selenium surface is to increase the conductivity. The nature of the action is important and should be investigated further.—*Physical Review*, March, 1912.

Ionization by Moving Electrified Particles.—J. J. Thomson.—A theoretical paper developing a theory based on the following assumptions: Cathode or positive rays when they pass through an atom repel or attract the corpuscles in it and thereby give kinetic energy to them. When the energy imparted to a corpuscle is greater than a certain definite value—the value required to ionize the atom—a corpuscle escapes from the atom, producing a free corpuscle and positively charged atom.—*Philos. Mag.*, April, 1912.

Dispersion of Liquid Chlorides.—H. H. Marvin.—An account of an experimental investigation of the selective transmission and the dispersion of liquid chlorides. The transmissivity of each ten liquid chlorides investigated (sulphur chloride, carbon tetrachloride, etc.) in the region 1.5 μ to 16 μ was measured and the refractive indices of eight liquid chlorides for a wide range of wave-lengths were determined. The Maclaurin and the Sellmeier dispersion formulas represent equally well the observed values of the refractive indices of the liquid chlorides. The value of the constant K in the Maclaurin formula is in good agreement with the observed value of the dielectric constant in each case, while the value of K in the Sellmeier formula differs by an amount which increases with the value of the dielectric constant. The Maclaurin formula is, therefore, in better accord with the results of experiment than is the Sellmeier formula.—*Physical Review*, March, 1912.

Contact Difference of Potential and Velocities of Electrons.—K. T. Compton.—An account of an experimental investigation of the influence of the contact difference of potential between the plates emitting and receiving electrons liberated by ultra-violet light on the measurement of the velocities of these electrons. The electrons moving between the emitting and receiving plates are acted on by the force due to the contact difference of potential as well as by the externally applied field. This effect must be allowed for when making measurements on the velocities of the electrons. When this contact difference of potential is corrected for, it is found that different metals, under the action of ultra-violet light, give off electrons with practically equal velocities. The "distribution of velocity" curves are also nearly identical. The evidence of reflected electrons re-

mains unimpaired. When a perforated screen and an auxiliary field are used to prevent this reflection, there is a stray field through the screen which may be calculated and corrected for.—*Philos. Mag.*, April, 1912.

Electron Theory.—O. W. RICHARDSON.—A mathematical paper discussing some applications of the electron theory of matter, especially to electrical and thermal conductivity and the law of force which governs the collisions of electrons in metals; the emission of electrons from hot bodies as a function of temperature; the reflection of electrons at the surface of conductors; the electron theory of contact emf and thermoelectricity, and photoelectric and related phenomena.—*Philos. Mag.*, April, 1912.

Rotating Electric-Current Field.—A. E. KENNELLY.—His Turin Congress paper in full, in which he deals with some new quantative relations bearing on Ferraris' rotating vector theory in relation to electric-current flow in two dimensions.—London *Electrician*, April 19, 1912.

Thin Metal Films.—J. ROBINSON.—An account of an experimental investigation of the photo-electric properties of thin metal films. One of the curious results found is that light assists electrons to leave a metal more in the direction of the light than in the opposite direction for thin films, but when the films are thick the reverse is the case.—*Philos. Mag.*, April, 1912.

Electrochemistry and Batteries.

Induction Furnace.—MAGNUS UNGER.—An article illustrated by diagrams on the action of electromechanical forces on the bath of induction furnaces. The author distinguishes two different kinds of forces. The first is the mutual attraction of current-carrying elements within the bath, similar to the attraction of two parallel conductors carrying current in the same direction. This effect is well known under the name of pinch effect. It does not manifest itself to a serious degree in large induction furnaces for steel refining, but makes it impossible to operate induction furnaces having a bath of very low specific resistance, such as aluminum and copper. The second force is the repelling force between the bath (secondary winding) and the primary winding, similar to the repelling force between two parallel conductors carrying current in opposite directions. This force resembles in many respects the effect that the centrifugal force caused by rotating the circular bath on its axis would have. The author analyzes this centrifugal effect in some detail with the aid of diagrams and finally points out that the pinch, as well as the centrifugal force, exerts a compressive effect upon the bath, and one which is of great value in tending to free it from inclosed gases and thus give a homogeneous product. The circulation set up in the bath by the magnetic forces is very desirable in order to obtain a uniform product.—*Metall. and Chem. Eng'ing*, May, 1912.

Electric Zinc Furnace.—C. F. JOHNSON.—An illustrated article on the electric zinc furnace of Woolsey McA. Johnson. In order to economize in electrical energy consumption the furnace charge is preheated to 900 deg. C. and electrical heat is employed only for the temperature range from 900 deg. to 1300 deg. C. An estimate of the power needed in commercial units for a 30 per cent ore is 800 kw-hr. per short ton 30 per cent roasted ore and 1400 kw-hr. per short ton 70 per cent roasted ore. The usual troubles with blue powder seem to have been greately reduced, as the best record of condensation in this respect was the production of 390 lb. of metal and only 11 lb. of blue powder. In commercial practice the amount of blue powder will be proportioned to secure the best economic results, a maximum of condensing output with a minimum of blue powder.—*Metall. and Chem. Eng'ing*, May, 1912.

Magnetic Separation.—O. E. RUHOFF.—An illustrated account of laboratory experiments on the magnetic separation of zinc-iron ores such as are found in southwestern Wisconsin. The results appear to show that after a light roast in any atmosphere which is not strongly oxidizing there is every probability that a magnetic separation of such zinc-iron ore can be satisfactorily carried out without losing so much sulphur that the iron tailings are no longer of value to acid manufacturers.—*Metall. and Chem. Eng'ing*, May, 1912.

Units, Measurements and Instruments.

Deflection Potentiometer.—H. B. BROOKS.—An account of the use of deflection potentiometers for current and voltage measurements. The deflection potentiometer combines, in suitable proportions, the accuracy and reliability of the zero potentiometer with the quickness of working, ease of reading and independence of fluctuations which characterize a well-damped deflection instrument. It is, therefore, especially suitable for a large class of work which does not require extreme precision but for which a high degree of reliability is wanted. With a deflection potentiometer in use, the manipulation and reading require but little more training, effort or time than the reading of a portable instrument, and every day's work of instrument checking is done as it should be, namely, by reference to standard resistors and standard cells.—*Bulletin Bureau of Standards*, Vol. VIII, No. 2, 1912 (Reprint No. 172).

Design of Deflection Potentiometer.—H. B. BROOKS.—In a second paper the author points out that, while the essential principle of operation of the deflection potentiometer is very simple, the requirements of speed of working, accuracy and the use of a pivoted portable galvanometer demand considerable care in the design. He gives an outline of the design in some detail, and also adds some notes on the design of a moving-coil galvanometer of the high grade required for a deflection potentiometer.—*Bulletin Bureau of Standards*, Vol. VIII, No. 2, 1912 (Reprint No. 173).

Electrical Instruments.—J. REYVAL.—The first part of an illustrated description of new instruments and apparatus exhibited at the recent exposition of the French Physical Society. The present instalment is especially devoted to description of new apparatus of A. Blondel, which were a feature of the exposition, comprising new oscillographs, a new photographic recorder, an apparatus for the harmonic analysis of periodic current waves, a resonance induction galvanometer, a polyphase arc lamp and various photometric instruments. An apparatus by Epstein and Armagnat for magnetic tests of sheet iron is also described.—*La Lumière Elec.*, April 20, 1912.

Resonance Method of Harmonic Analysis.—R. BEATTIE.—An illustrated mathematical article which contains an examination of the errors to which the experimental or resonance method of harmonic analysis is liable. In the course of the discussion a process of correcting for these errors is described. It is likewise shown how by a slight variation of the usual procedure a considerable improvement in the attainable accuracy can be secured.—London *Electrician*, April 19, 1912.

Thermo Emf of the Nernst Filament.—J. S. SHEARER.—An abstract of an American Physical Society paper giving the results of some preliminary determinations of the thermo-electric power of the Nernst filament, which was found to be more than forty times that of platinum platinum-rhodium in the temperature interval from 20 deg. to 440 deg. C.—*Physical Review*, March, 1912.

Resistivity Measurement of Magnesium.—E. F. NORTHRUP.—An illustrated article describing a resistivity determination of magnesium in the temperature range from 20 deg. to 155 deg. C., which is intended as an illustration of the best methods by which such measurements should be made and recorded. The method is based on the use of the Kelvin double bridge.—*Metall. and Chem. Eng'ing*, May, 1912.

Telegraphy, Telephony and Signals.

Long-Distance Telephony.—BELA GATI.—An account of an experimental comparison of the Egner-Holmstrom

microphone (recently described in the *Digest*) and the microphone of Gati, of the water-cooled type. For a third comparison a Berliner microphone was used. The tests were made over a line of 1200 km (720 miles), which was arranged in such a way that the wave-forms of the current at the transmitting end and at the receiving end could be plotted by the same oscillograph. Two men spoke the same vowel into the microphone at the receiving end and the curves of the current show, in the opinion of the author, that only the Gati microphone gives for every vowel the same characteristic current curve independent of the person who has pronounced the vowel.—*La Lumière Elec.*, April 20, 1912.

Miscellaneous.

Corrosion of Iron and the Protection of Structural Ironwork.—L. Archbutt.—A note on a paper read before the Derby Society of Engineers. The author prefaced his remarks by a discussion of the various theories of the cause of corrosion. He showed that moisture is a necessary concomitant and also considered the effects resulting from the presence of carbonic acid, hydrogen peroxide and bacteria. He then dealt very fully with the proper methods for preserving iron or steel structures subject to atmospheric rusting. A coating of oxide scale is one means of preventing this, though this coating is liable to crack or flake off if the metal is hammered or bent. Other processes designed for the same purpose are tinning and galvanizing, these being extensively employed. For structures exposed to the atmosphere, however, by far the most widely adopted and convenient method is painting. Paints for ironwork might be divided into two classes: (1) Varnishes, containing no pigment, bitumen, coal-tar pitch, stearine pitch or wool pitch in tar oils, and (2) true paints, composed of a finely ground pigment suspended in a vehicle which is usually linseed oil. Before applying paint, however, the iron should be dry and free from traces of rust. The paint should be put on very thickly and while the iron is dry and even warm. Nothing is better for employment as a priming coat than red lead and linseed oil. Portland cement is a good protective in places where water lodges. For the preservation of underground iron Angus Smith's method is one of the most successful. The action of water upon iron in hot-water pipes and in steam boilers is very different. In cases where water is so soft as to deposit no protective coating of carbonate of lime in the pipes the presence of carbon dioxide might lead to serious corrosion. Such water has, however, no perceptible action on copper. Hard water, though commonly considered more corrosive than soft water, has often, owing to the deposition of carbonate of lime in the pipes, a less harmful action than soft water. —London *Electrician*, April 19, 1912.

National Employees' Insurance.—J. H. Stansfield.—An article on the proposed British law on national insurance with special reference to the electrical industry.—London *Elec. Review*, April 19, 1912.

Book Reviews

Wechselstromversuche. By Dr. Anton Lampa. Braunschweig: Friedr. Vieweg & Sohn. 176 pages, 54 illus. Price, 5.80 marks.

A textbook on alternating-current theory from the algebraic or non-vectorial standpoint. It is divided into a brief introduction and four chapters, which relate to the following subjects: Alternating-current flow; induction and mechanical forces; the rotating magnetic field; the rotating electric field. The book is written in a scholarly style and enters deeply into a number of subjects not ordinarily dealt with in alternating-current treatises. It is prepared more from the standpoints of mathematics and physics than from that of electrical engineering. The book will be of interest to advanced students of electromagnetics.

The Magnetic Circuit. By V. Karapetoff. New York: McGraw-Hill Book Company. 243 pages, 62 illus. Price, $2.

Detailed discussions of the electrophysical relations in the magnetic circuits of all practical types of dynamo-electric machinery, transformers and transmission lines are given in this book, which has been written with the object of providing the advanced electrical engineering student with accurate information concerning the factors which affect the operating characteristics of such apparatus. The thirteen chapters deal with the following topics: The fundamental relation between flux and mmf, the magnetic circuit with iron, hysteresis and eddy currents in iron, induced emf in electrical machinery, exciting ampere-turns in electrical machinery, mmf of distributed windings, armature reaction in synchronous machines, armature reaction in direct-current machines, electromagnetic energy and inductance, the inductance of cables and transmission lines, the inductance of the windings of electrical machinery, and the mechanical force and torque due to electromagnetic energy. In two appendices the ampere-ohm system of units and the ampere-turn versus the gilbert are discussed. Clearness of presentation characterizes the treatment throughout. Moreover, numerical problems are inserted at the end of nearly every article in the book in order to permit the student to fix the relations definitely in his mind. As a test for students the book should be welcomed by instructors in high-grade electrical engineering colleges.

The Induction Motor. By Benjamin F. Bailey, Ph.D. New York: McGraw-Hill Book Company. 225 pages, 120 illus. Price, $2.50.

After outlining briefly the elementary theory of the induction motor and then discussing more completely and thoroughly the performance of the machine as disclosed by the simple circular current diagram, the author deals in some detail with the starting torque of the machine and starting devices used with it. Variable-speed induction motors of the cascade, changeable-pole-number and commutator types are described in a simple manner, as is also the induction generator. The last half of the book deals more largely with design than with operation, which latter, however, is discussed as having a bearing on design. The treatment is as nearly non-mathematical as one could desire for presenting such involved interrelations as exist in the induction motor. In fact, the few equations used are little more than simple algebraic expressions of the physical relations and are seldom used by the author to demonstrate any theory proposed. The author has exercised good judgment in the arrangement of the material in the book, which is well adapted for purpose of instruction in design, theory and operation characteristics.

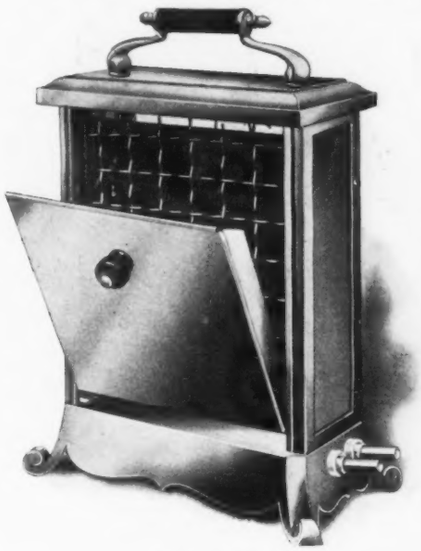
Alternating-Current Design. By Julius Frith. New York: D. Van Nostrand Company. 118 pages, 27 illus. Price, $2.

Although the number of separate design subjects embraced by this brief treatise renders impossible the thorough treatment of them all, yet most of the important features are dealt with in each case. This desirable result is attributable to the fact that the author has made an excellent selection of material to include in the book and has excluded all matter of minor importance. Design theory and constructive details are given relating to alternating-current generators, synchronous motors, induction motors, stationary transformers and transmission lines. The treatment is essentially non-mathematical and is of such a character as to appeal most strongly to practising designers.

New Apparatus and Appliances

ELECTRIC TOASTER.

The accompanying illustration shows a new-type electric toaster which has just been put on the market by Simplex Conduits, Ltd., of 116 Charing Cross Road, London. It embodies many improvements in design and construction. The base and frame are one casting, designed in a style



Electric Toaster.

which has proved to be the most popular. The heating element consists of a resistance tape of special composition spirally wound on thin rectangular mica strips which are supported one above the other on the frame. Two slices of bread can be toasted at the same time, and these are held in the correct position for toasting by two hinged sides, which also serve to retain the heat. The current consumption is low, but the construction is such as to give very rapid toasting. The device is nickel-plated and furnished with two pin terminals.

SOLDER FOR ALUMINUM.

It is generally recognized that the difficulty in soldering aluminum in a permanent manner is attributable to the oxide of aluminum which is always present on the metal. Even when the metal is scraped it re-forms quickly, and it is of a tenacious and obstinate nature. Many attempts to obtain solders for aluminum have failed because the contact formed is destroyed in a short time by the action of the oxide. It is claimed that a special combination flux and solder invented by Mr. Charles M. Brown will produce a permanent contact which will withstand the most searching atmospheric and chemical tests. It is stated that only a small quantity of the material is required to make a joint. The parts to be united are first scraped and then the combined solder-flux (which is in paste form) is put on. Heat can be applied by means of an alcohol lamp (for small work), a blow torch, Bunsen burner or the acetylene and oxygen welding flame. The solder runs automatically into the joint. The melting point is about 300 deg. C. and the process may be more correctly described as autogenous welding. In joining thick stranded aluminum cables use is made of a special method by which molten aluminum is poured into the joints. The flux is supplied in powder form and is made into a paste by the user. The solder is composed of an alloy of aluminum and can be polished in the same way as aluminum. This material has been placed on the market by the Alu-Sol Manufacturing Company, Worcester Street, Wolverhampton, England.

HIGH-VOLTAGE OUTDOOR TRANSFORMER.

The transformer illustrated herewith was built for use by the Southern Sierras Power Company for outdoor service on 33,000-volt, 60-cycle circuits. It is of the shell-type construction, with separately wound primary and secondary coils. Each coil has a continuous layer of insulation and is spaced and separated from the other coils by means of heavy insulating channels and shields. The primary winding is so arranged that the taps are brought out from the interior or neutral part of the winding in order to minimize danger of trouble at this point. The terminal block is submerged in oil. The wire used in the high-voltage winding is first enameled and then double cotton-covered. That portion of the winding which connects to the line has four cotton coverings, and the last turns of each coil are furthermore individually wrapped with a double thickness of varnished cambric or empire cloth so that each turn will withstand several thousand volts break-down test. This extra heavy insulation on the end turns is to enable the transformer to stand up under high-frequency discharges and line surges.

The high-tension insulators, tested at 80,000 volts, are cemented to an auxiliary cover bolted to the main cover.

High-Voltage Transformer for Outdoor Service.

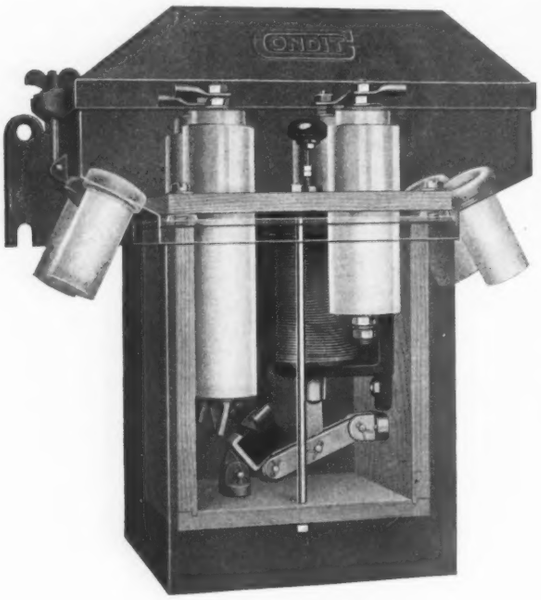
After the core, coils and main cover are in place the final connections between the coils and the high-tension terminals are made through an additional hand-hole in the main cover, which at the same time provides a convenient means of filling the transformer with oil. It is said that the transformers have successfully withstood break-down tests of

70,000 volts between primary and secondary and ground. This transformer was built at the Fort Wayne Electric Works of the General Electric Company.

REMOTE-CONTROLLED SWITCH.

The accompanying illustration shows a remote-controlled switch for controlling small incandescent lamp circuits used for signs and for lighting in alleys and such places which it is desired to operate during the same hours as the street-lighting circuits. The coil shown is connected in series with the main lamp circuit and the contacts controlling the secondary lamp circuit. The closing of the main circuit energizes the coil, which closes the contacts of the secondary circuit.

To open the switch the main circuit must first be interrupted and then a small amount of alternating current sent through the main arc circuit and this coil. This alternating current demagnetizes the iron core so that the switch immediately opens. To open the switch ½ amp of



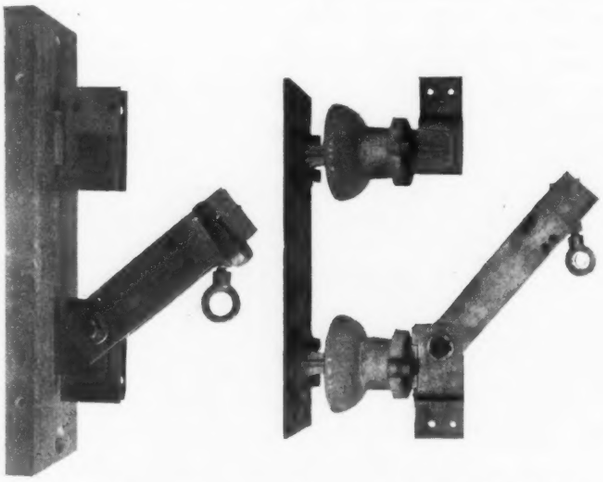
Remote-Controlled Switch.

alternating current forced through the circuit is sufficient and is not enough to injure any of the magnetic apparatus connected to the circuit. The switch is manufactured by the Condit Electrical Manufacturing Company, Boston, Mass.

LOCK-TYPE DISCONNECTING SWITCHES.

The increasing size of electric generating plants has created a demand for disconnecting switches of large current-carrying capacity and of a type which eliminates the dangerous features of the ordinary knife switches. In Fig. 1 herewith is shown a 2200-volt, 2000-amp lock-type disconnecting switch mounted on a marble slab. The stationary contacts are suitable for cable and bar connection, the movable parts consisting of four blades and a clamping attachment. Fig. 2 shows a switch for 12,000 volts and 1000 amp, mounted on insulators.

The experience with ordinary knife switches of 800 amp or more on large generating systems led to the adoption of a lock-type knife switch to prevent the opening of the switch under heavy short-circuits and subsequent destruction of the switch and surroundings. The switches are locked and unlocked in less than one turn of the handle. The quality of the contacts does not depend on any springing of the parts in contact. The clamping effect insures the low resistance of the contacts and increases actually the current-carrying capacity of the switch. The switch can be built to suit any current requirements and is very easy



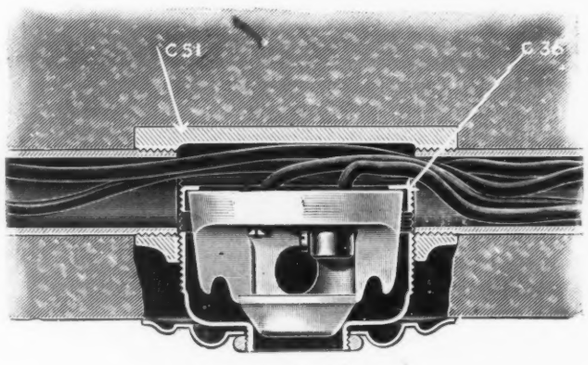
Figs. 1 and 2—Lock-Type Knife Switches for 2000 Amp and 1000 Amp Respectively.

to operate when unlocked, a light pull on the eye-bolt serving to open the switch.

This type of switch has been adopted as standard with the Shawinigan Water & Power Company, of Montreal, where more than 300 are in use at present. It has been patented in Canada and the United States. It is being marketed by Mr. John Morse, Power Building, Montreal, Can.

ADJUSTABLE CONDUIT BOXES.

In installing concealed conduit systems for house wiring the adjustment necessary to bring the switch plate flush with the finished wall often causes some trouble. One feature of the box illustrated herewith is the adjustment ring, C 36, which can be moved forward or backward, allowing 0.5-in. adjustment. An extension ring is available for extreme cases, which increases the depth of the box to any extent. The switch plate is slipped over the projecting wall



Adjustable Conduit Box.

thread in the cover and automatically adjusts itself to the level of the plaster. Ample space can be left at the back of all fittings for joints and switches. The boxes are manufactured in standard conduit sizes by the Sun Electrical Company, Ltd., 118-120 Charing Cross Road, London, W. C., England.

Industrial and Financial News

BUYING continues on a very conservative scale throughout the greater part of the country, and the trade situation as a whole shows signs of irregularity. Hesitancy is again apparent in fresh commitments, and while the movement of merchandise is of fair proportions, it seems to be chiefly of routine nature. Optimistic sentiment received a check last week from the unfavorable showing made by the United States Steel Corporation in the first quarter of the year, and this has been augmented by uncertain crop and labor conditions in various sections. According to the government crop report issued May 7, weather conditions last week were favorable to the crops, but it is generally believed at this time that the season will be a backward one. Retail lines are showing fair activity. Building operations during the month of April showed marked expansion, and further encouragement is found in the tendency toward higher prices in the metal markets. While the political developments are being watched with interest, they are apparently exerting only a secondary influence on business. Money continues easy. Rates in the New York market May 8 were: Call, 2¾@3 per cent; ninety days, 3@3¼ per cent.

Chicago Elevated Railways.—A communication from the law department of the city of Chicago giving an opinion as to the power of the City Council to enforce a universal 5-cent fare by transfer among the various elevated-railway companies of the city includes an interesting exposition of the legal status of the present agreement, or consolidation, if it can be called such, between the elevated-railway companies of Chicago. The opinion, dated April 22, was prepared by John W. Beckwith, assistant corporation counsel, and approved by William H. Sexton, corporation counsel. It relates that during the summer of 1911 Henry A. Blair purchased about 98 per cent of the stock of the Northwestern South Side and Metropolitan companies. This stock was transferred to three individual trustees, of whom Mr. Blair is one, and it was pledged to secure notes amounting to $30,000,000. Subject to this pledge the trustees have also issued to the beneficiaries under the trust certificates called shares, and these shares have been sold and distributed by the trustees. The opinion continues: "This form of organization is not a form of incorporation, but is commonly known as the 'Massachusetts trust plan,' and is a name adopted for convenience as the authorized designation for business purposes of the trustees. No one corporation controls the stock of any of the elevated roads, nor does any of the elevated-railroad corporations own or control the stock of either of the others. A somewhat fictitious separate legal and corporate entity of each elevated-railroad corporation is kept up and maintained and each railroad company mentioned is being operated under and through a board of directors and officers elected or appointed by such board or boards, and perhaps technically, at least, each elevated railroad is independent of the others." However, while the question is not without doubt, the corporation counsel is inclined to believe that a court would hold that the real beneficial owner of the properties is the board of trustees of the voting trust. It would seem to be in accordance with sound public policy, he concludes, not to allow these corporations to defeat a demand for betterment of service by a subterfuge.

H. M. Byllesby & Company to Buy Minneapolis General Electric Company.—It is learned from an authoritative source that the negotiations of Stone & Webster for sale of a majority of the capital stock of the Minneapolis General Electric Company at $120 for the preferred and $200 for the common have been made in the interest of H. M. Byllesby & Company, of Chicago. More than a majority of the stockholders have signified their approval of the transaction at the prices named above. The following letter has been sent by Stone & Webster to the stockholders of the Minneapolis General Electric Company: "With the approval of directors we have undertaken negotiations for sale of not less than a majority of the capital stock of this company at $120 a share for the preferred and $200 a share for the common. All stockholders may benefit from this sale, if made, provided they deposit their stock certificates with Stone & Webster on or before May 15, 1912. Our negotiable receipts will be issued for the certificates so deposited, and in the event the same takes place will be redeemed at the amounts above stated, less 1 per cent of the selling price, as commission for our services, and less our expenses, which shall not exceed an additional 1 per cent. If the sale does not take place before July 15, 1912, the certificates will be returned without cost upon surrender of the receipts."

Chicago Sanitary District Contracts.—The Sanitary District of Chicago has entered into a contract with the Standard Underground Cable Company, of Pittsburgh, by which the latter will supply about 50,000 ft. of single-conductor (No. 6 B. & S. gage) lead-covered cable for 7000-volt underground alternating-current arc circuits at 12.8 cents a foot; also for three-conductor and four-conductor cable for operating voltages of 12,000 and 5000, of varying sizes of wire, at prices ranging from $0.323 to $1.359 per foot; also single-conductor (No. 6 gage) lead-incased and armored cable at 20.1 cents a foot, about 25,000 ft. being required. Of the three-conductor, 12,000-volt cable, with wires of No. 00 and No. 0000 gage, at least 15 miles will be required. The Sanitary District has also voted to enter into contract with Machado & Roller, Inc., for switchboard ammeters at $10.95 each. The cables and instruments will be used as a part of the new arc-lighting system of the city of Chicago.

Montana Power Developments Planned.—Interests associated with the Northwestern Development Company, of Seattle, Wash., the Butte Electric & Power Company, of Butte, Mont., and other electric companies in the State of Montana are planning to build a power station at Thompson Falls, Mont., from which energy will be furnished to the northwestern part of the State. According to statements credited to Max Hebgen, general manager of the Butte Electric & Power Company, about 66,000 hp will be developed ultimately at Thompson Falls. John D. Ryan, Louis Agassiz, of Boston; J. G. Morony, of Butte, and Edward Donlan, president of the Northwestern Development Company, are among those named with Mr. Hebgen as interested in the project.

Isthmian Canal Proposals.—Circular No. 707 of the Isthmian Canal Commission, Washington, D. C., invites proposals up to 10.30 a. m., May 20, 1912, on electric cable, wire, fuses, sockets, plugs, dry cells, vulcanized red fiber, wire solder and wire clamps. Copies of this circular, giving specifications and information for prospective bidders, can be obtained upon application to the offices of the commission at Washington, D. C., and at the offices of the assistant purchasing agents, 24 State Street, New York; 614 Whitney-Central Building, New Orleans, and 1086 North Point Street, San Francisco. Copies may be had also at the United States engineer offices in the majority of the large cities throughout the country.

Louisville Lighting Companies.—It is announced that the time during which shares of stock in the Louisville Gas Company, which controls the Louisville Lighting Company, may be included in the pool of the stock formed by the Louisville Trust Company and the Fidelity Trust Company has been extended to May 15. The two companies have received 17,000 shares of stock, which with the 6000 shares already held by H. M. Byllesby & Company, for whom the pool is being formed, will give them 23,000 shares of a total of 36,000. The extension is expected to result in at least 3000 additional shares being turned over.

Goldsboro (N. C.) Municipal Plant Sold.—The Carolina Power & Light Company, of Raleigh, N. C., has purchased the municipal electric light plant at Goldsboro, N. C. The price paid for the plant was said to be $125,000, including a sixty-year franchise. The city retains ownership of the water-works, to which the power company will furnish energy for pumping.

Robinson (Ill.) Plant to Be Sold by Receiver.—By order of the court Willis H. Clinton, receiver of the Robinson Water, Light & Heat Company, will sell at auction at the office of the company in Robinson, Crawford County, Ill., at 10 a. m. on May 23, all the property and franchises of the company. No bid for less than $100,000 will be considered. Robinson is in the Illinois oil field. The main generating unit of the central station consists of a 225-hp Diesel oil engine direct-connected to a 200-kva Fort Wayne three-phase, 60-cycle, 2200-volt alternator. E. B. Pollister, manager for the receiver, says that the oil engine has been operating on a twenty-four-hour schedule for twenty months with a shut-down of less than three hours due to any operating fault. Otherwise the plant has been operated continuously with a five-hour shut-down every Sunday. Crude oil costing 1.9 cents a gallon is used and the kilowatt-hour cost on 30 per cent load-factor is figured at 8.5 mills for labor, fuel and maintenance. The waterworks pumping plant is steam-operated. The receiver was appointed, it is said, because the former plant of the company was inadequate to the demands of the business. He issued certificates and rebuilt the plant, which is now said to be in good condition. The company has a water franchise expiring in 1939 and an electric franchise expiring in 1931, also a ten-year street-lighting contract running from Sept. 1, 1909. There are sixty-five street arc lamps, paid for at $60 a year each. The company has 314 electric-light customers and supplies energy to 100 hp in motors.

Financial Matters Before Vermont Public Service Commission.—On May 16 the Vermont Public Service Commission will give an adjourned hearing at Rutland upon the petition of the Clarendon Power Company for authority to increase its outstanding stock and bonds. On May 17 the board will sit at Burlington upon the petition of the Burlington Traction Company for the right to issue bonds in the sum of $500,000. The proceeds of the issue are desired to pay for the property of the Vergennes Power Company, which the petitioner desires to purchase, to retire outstanding bonds due in 1913, and for the further extension and improvement of the property and system of the Burlington Traction Company. On May 23 the commission will sit at its office in Newport to hear a petition of the Newport Electric Light Company for authority to increase its capital stock to pay for about $45,000 in improvements made during the past four years.

Coast Valley Gas & Electric Offering.—Denver interests are offering first-mortgage 6 per cent gold bonds of the Coast Valley Gas & Electric Company, of Monterey, Cal., which does the entire electric and gas business in Monterey, Salinas and Pacific Grove, Cal., and owns the water system of Salinas and also the entire capital stock of the Monterey & Pacific Grove Railway Company. The authorized capitalization of the company consists of $2,000,000 preferred stock, $3,000,000 common stock and $10,000,000 first-mortgage 6 per cent bonds, the present issue of which is $786,000. The company has electric plants at Monterey and Salinas with an aggregate equipment of 1700 hp and 71 miles of distribution system. The total hourly output rating of its gas plants is 17,500 cu. ft., and there are 30 miles of mains.

Construction on Clarion River Project to Be Started Shortly.—Work on the power developments of the Clarion River Power Company, on the Clarion River, Clarion County, Pa., is to be undertaken within a short time, according to statements made this week. This company, as noted in these columns April 27, 1911, plans to spend several millions of dollars in building hydroelectric plants in the territory named above and to supply energy throughout a large part of the State. J. R. Paull, of Pittsburgh, is treasurer of the company. Others associated with him in the project are H. W. Douglass, J. P. Fife, M. L. Benedum and J. C. Trees. The Clarion River company has taken over thirteen charters which were granted to various corporations in connection with this enterprise.

Earnings of Rio de Janeiro Tramway, Light & Power Company, Ltd.—The report of the Rio de Janeiro Tramway, Light & Power Company, Ltd., for the year ended Dec. 31, 1911, shows gross revenues of $12,952,317, comparing with $10,960,180 in 1910. After all deductions, the surplus for the year was $3,708,595, against $2,337,143 in the preceding year. Dr. F. S. Pearson, president of the company, stated in the report under date of April 9, 1912, that satisfactory progress had been made in all departments of the company. Steady growth was shown in both the electric-light and the motor-service branches. The increase in service during the year was as follows: In motors, 14,843 hp; incandescent lamps, 115,568; arc lamps, 2,271, and electric fans, 234.

Ex-head of United Wireless Company Has No Assets.—Colonel Christopher C. Wilson, former president of the United Wireless Telegraph Company, who is serving a term in the federal prison at Atlanta for fraudulent use of the mails in connection with the sale of stock of the wireless company, was brought before United States Commissioner Alexander in New York this week, as a result of efforts on the part of the creditors and receivers of the concern to determine what disposition he had made of funds belonging to the company. Questioning by Robert T. Whitehouse, counsel for the creditors, and Saul S. Meyers, counsel for the receiver, disclosed the fact that the only asset now possessed by the wireless promoter was his watch.

End of National Telephone Receivership in Sight.—Important developments in connection with the receivership of the National Telephone Corporation, of West Virginia, which owns a controlling interest in a number of telephone companies operating in the South, are reported. Advices from Wheeling, W. Va., say that local stockholders have received information that John A. Howard, former president of the company, will make an offer to buy up the stock of the corporation at its par value. It is expected that the receivership will be ended as a result of this offer.

Cleveland Electric Illuminating Sale.—Stockholders of the Cleveland Electric Illuminating Company are considering the advisability of taking stock in the Central States Electric Company, the holding company which, it is said, has been organized to take over their stocks in case they decide to sell under the offer made by Harrison Williams, previously mentioned in these columns. Some of them, it is said, are willing to accept 60 per cent cash for their stock and 40 per cent in preferred stock of the holding company.

Subscription Limit to Hall Signal Plan Extended.—The time within which subscriptions can be received to the reorganization plan of the Hall Signal Company, referred to in these columns April 6, has been extended to May 17, after which date no subscriptions will be received except under such penalty as the reorganization committee may impose. The plan already has the approval of a large number of the stockholders.

United Light & Railways Sells Bonds.—New York and Chicago banking houses have purchased $4,375,000 first and refunding 5 per cent bonds of the United Light & Railways Company, Grand Rapids, Mich., which the latter has sold in accordance with its financial plan for acquiring the Tri-City Railway & Light Company. Details of this merger were given in these columns March 23, page 656.

Charter for Savannah Power Company.—Advices from Savannah, Ga., state that a $1,000,000 charter has been granted to the Savannah Power Company, which will build a large power station for the Savannah Electric Company. The incorporators are George J. Baldwin, Marcey L. Sperry, Jacob Paulsen, Bierne Gordon and John A. G. Carson.

Investigating West Virginia Water-Power Sites.—The possibilities of water-power sites on the Black Fork River, in Tucker County, in West Virginia, are being investigated by engineers in the interest of the Black River Water & Power Company, a twenty-seven-million-dollar corporation in which the Kuhns, of Pittsburgh, are active.

Pacific Gas & Electric's Year.—Gross revenue of the Pacific Gas & Electric Company in the year ended Dec. 31, 1911, was $14,604,609, an increase of $305,381 over the returns in 1910. The balance available for dividends on the common stock after payment of fixed charges was $1,687,505, an increase of $135,761.

Federal Light & Traction Director.—Howard Bayne, vice-president of the Columbia Trust Company, has been elected a director of the Federal Light & Traction Company, 60 Broadway, New York.

Union Coal & Electric Company (Cal.) Stock Offered.—Development of the coal resources of San Benito County, Cal., and the transmission throughout that section of electrical energy produced at its mines by generators driven by engines which will be supplied with gas from a producer system, is the plan of the Union Coal & Electric Company, of Los Angeles, Cal., as set forth in a circular devoted to the affairs of the company. This shows that the company was organized under California laws on Dec. 6, 1911, with a capital of $1,000,000 common stock, in shares of one dollar each, and that it owns over 1000 acres of coal in San Benito County. Shares are being offered by the company.

Federal Light & Traction Earnings Up.—According to the consolidated statement of earnings of the subsidiaries of the Federal Light & Traction Company, 60 Broadway, N. Y., for the twelve months ended March 31, 1912, gross revenues in that period showed an increase of 7.08 per cent over those in the corresponding period of 1911. Net earnings showed a gain of 4.15 per cent. The statement does not include the operations of the Trinidad Electric Transmission, Railway & Gas Company, as this company was not acquired until September, 1911.

Report of National Electric Signaling Company.—A statement of the condition of the National Electric Signaling Company, as of Dec. 31, 1911, shows total assets of $1,298,250, made up as follows: Real estate, $267,058; merchandise, material and stock in process of manufacturing, $196,470; cash and debts receivable, $115,360; patent rights, $339,585, and profit and loss, $1,298,250. Liabilities shown were: Capital stock, $100,000; accounts payable, $27,072; floating indebtedness, $1,099,178, and surplus, $72,000.

Doherty Injunction Against American Gas & Electric Denied.—The application of H. L. Doherty & Company to make permanent a temporary injunction to restrain the American Gas & Electric Company from issuing $500,000 additional common stock, pending settlement of their suit to enforce their right to subscribe for $1,000,000 common stock upon which they claim to hold an option, as outlined in these columns April 13, has been denied.

A North Carolina Hydroelectric Company Organized.—The Alamance Power Company has been organized by North Carolina interests for the purpose of building a hydroelectric plant at River Falls on the Haw River in Alamance County, N. C. The officers of the company are: President and treasurer, F. L. Williamson, of Burlington; vice-president, J. H. White, of Graham, and secretary, C. E. Menefee, of Burlington.

Earnings of the Union Gas & Electric Company, of Cincinnati.—A check for $2,703.45 has been received by City Auditor Washburn, of Cincinnati, from the Union Gas & Electric Company, as 0.5 per cent of its gross earnings for the first three months of 1912, as required under its contract with the city. This shows that the gross earnings for the period were $540,690.73.

May Increase Dividend of Montreal Light, Heat & Power Company.—There is a belief in financial circles at present that the Montreal Light, Heat & Power Company's quarterly dividend rate of 2 per cent will be increased to 2¼ per cent when the next dividend is declared. If this change is made the stock will be placed on a 9 per cent basis, comparing with 7 per cent in 1910.

Canadian General Electric Financing.—Stockholders of the Canadian General Electric Company have approved an increase in the capital stock of the company from $7,700,000 to $12,000,000. Of the new stock, $2,000,000 is preferred. The proceeds of the sale of the stock will provide the company with funds to retire advances made by its bankers.

Chicago-Milwaukee Electric to Sell Bonds.—New York bankers will underwrite $4,500,000 first-mortgage bonds of the Chicago-Milwaukee Electric Company. The proceeds of the sale will be used to retire $1,000,000 of old first-mortgage bonds at 105 to pay off $1,500,000 receiver's certificates and to provide working capital.

Changes in Board of New England Telephone & Telegraph.—Thomas B. Dailey and Charles H. Wilson were elected directors of the New England Telephone & Telegraph Company, succeeding John F. Hill and F. D. Proctor, at the annual meeting this week.

Central Union Telephone Calls Bonds.—The Central Union Telephone Company, controlled by the American Telephone & Telegraph Company, has called for payment on July 1, at 105, its $2,500,000 first mortgage 6 per cent bonds, due 1916, and $3,500,000 consolidated mortgage 5 per cent bonds, due 1919.

Annual Meeting of the General Electric Company.—At the annual meeting of the General Electric Company, on May 7, all retiring directors were elected with the exception of T. Jefferson Coolidge, Jr., for whom I. S. Keeler, assistant secretary of the company, was substituted.

New York Telephone Company Officials Re-elected.—At the annual meeting of the stockholders of the New York Telephone Company on May 7 the retiring directors were re-elected. The old officers were re-elected by the board at a subsequent meeting.

To Electrify Division of Pittsburgh & Lake Erie Road.—Electricity for motive power will be substituted for steam shortly on the line of the Pittsburgh & Lake Erie Railroad between Pittsburgh and the town of College.

Allis-Chalmers Plan Operative.—Sufficient assents to the plan for reorganization of the Allis-Chalmers Company having been secured, the committee has declared the plan operative.

APRIL STATEMENT OF COPPER PRODUCERS' ASSOCIATION.

The April statement of the Copper Producers' Association, issued May 8, compares with the March statement as follows:

	April, pounds	March, pounds
Stocks on hand in the United States on first of month	62,367,557	62,939,988
Production	125,464,644	125,694,601
	187,832,201	188,634,589
Domestic deliveries	69,513,846	67,487,466
Export deliveries	53,252,326	58,779,566
Total deliveries	122,766,172	126,267,032
Stocks on hand at the end of the month	65,066,029	62,367,557

PRICES IN THE NEW YORK METAL MARKET.

Copper:	May 1 Bid.	May 1 Asked.	May 8 Bid.	May 8 Asked.
Standard:				
Spot	15.50	15.75	15.35	15.60
May	15.50	15.75	15.37½	15.60
June	15.50	15.70	15.45	15.60
July	15.50	15.60	15.45	15.60
August	15.55	15.60	15.45	15.60
London quotation:	£ s d		£ s d	
Standard copper, spot	70 3 9		69 3 9	
Standard copper, futures	71 0 0		69 15 0	
Prime Lake	16.00		15.85	
Electrolytic	15.85		15.75	
Casting	15.79½		15.65	
Copper wire, base	17.00		17.00	
Seamless tubing, copper, base	23.00		23.00	
Seamless tubing, brass, base	20.00		20.00	
Lead	4.20		4.20	
Sheet zinc, f.o.b., smelter	8.65		8.65	
Spelter, spot	6.90		6.85	
Nickel	39.00 to 40.00		39.00 to 40.00	
Aluminum:				
No. 1 pure ingot	20@21		19@22	
Rods and wire, base	31		31	
Sheets, base	33		33	
OLD METALS.				
Heavy copper and wire	14.25		14.25	
Brass, heavy	10.00		10.00	
Brass, light	8.25		8.25	
Lead, heavy	4.20		4.20	
Zinc scrap	5.75		5.75	

COPPER EXPORTS IN MAY.

Tons, week ended May 8	5458

STOCK MARKET PRICES.

	May 1.	May 8.
Allis-Chalmers	1	1⅜*
Allis-Chalmers, pf.	3⅛	8*
Amalgamated Copper	83⅜	81⅛
Amer. Tel & Tel.	146⅜	145⅜
Boston Edison	292	292
Commonwealth Edison	146*	146*
Electric Storage Battery	55¼	54½
General Electric	169	167
Mackay Companies	83½*	82¾
Mackay Companies, pf.	68½*	69⅝*
Philadelphia Electric	18⅜	19¼
Western Union	84	83
Westinghouse	76½	74¼
Westinghouse, pf.	120	120⅜

*Last price quoted.

ANNUAL REPORTS.

AMERICAN LIGHT & TRACTION COMPANY.

The report of the American Light & Traction Company for the fiscal year ended March 31, 1911, compares with that for the previous year as follows:

	1912	1911
Gross earnings	$4,104,550	$3,933,091
Expenses	118,356	119,522
Net earnings	$3,986,194	$3,813,569
Previous surplus	7,158,380	6,245,814
Total	$11,144,574	$10,057,384
Preferred dividend	854,172	854,172
Common dividend	1,129,083	1,022,326
Stock dividend, common	1,129,107	1,022,505
Total dividends	$3,112,363	$2,899,003
Surplus, March 31	$8,032,211	$7,158,380

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY.

The statement of the New England Telephone Company for the fiscal year 1911 compares with that for 1910 as follows:

	1911	1910
Gross earnings	$13,849,394	$13,171,709
Operating expenses	5,521,267	4,956,860
Taxes	824,901	770,681
Repairs and depreciation	4,372,423	4,131,366
Total expenses	10,718,591	9,858,907
Net earnings	$3,130,803	$3,312,802
Interest	135,315	118,808
Dividends	2,644,521	2,350,686
Surplus	350,965	843,308

Personal

Mr. John L. Hopkins, who has been a director of the Georgia Railway & Electric Company, Atlanta, Ga., for some time, has been elected a vice-president of the company.

Mr. David Gibson, of Cleveland, Ohio, addressed the Electric Club of Chicago at the regular weekly luncheon on May 9, the subject of the address being "The Morals of Efficiency."

Mr. W. J. Massee has tendered his resignation as president of the Macon (Ga.) Railway & Light Company, the Central Georgia Power Company and the Macon Gas Company, to take effect May 15.

Mr. George A. Damon, dean of the School of Engineering of Throop Polytechnic Institute, Pasadena, Cal., delivered the annual engineering address at the University of California, Berkeley, Cal., on April 23.

Mr. C. S. MacCalla, general manager of the Washington Water Power Company, Spokane, Wash., lies seriously ill at the hospital in Spokane, where he recently underwent an operation for an abscess on the stomach.

Mr. W. W. Reed, general superintendent of the Houston Lighting & Power Company, is recovering from a fractured ankle incurred while directing emergency repair work. Mr. Reed was confined to the hospital nearly a month.

Mr. E. C. Butler has tendered his resignation as manager of the Albuquerque (N. M.) Gas, Electric Light & Power Company, to become effective June 1. Neither his successor nor his plans for the future have as yet been announced.

Mr. William A. Root, formerly purchasing agent of the Empire Gas & Electric Company, with headquarters at Auburn, N. Y., has accepted the position of new-business manager with the Bronx Gas & Electric Company, of Westchester, N. Y.

Mr. C. D. Williams, of the Simplex Heating Company, Cambridge, Mass., delivered an address on the uses of electricity in the home before the Worcester Polytechnic Institute Branch of the American Institute of Electrical Engineers on May 10.

Mr. P. S. Arkwright has resigned as president of the Georgia Railway & Electric Company, Atlanta, Ga., and has been elected president of the Georgia Railway & Power Company, which has leased the property of the Georgia Railway & Electric Company.

Mr. N. F. Obright, contract agent for the electrical department of the Sanitary District, has been appointed vice-president of the Electric Club of Chicago, to succeed **Mr. P. R. Boole,** who has resigned.

Mr. Joseph T. Orme has been elected president of the Georgia Railway & Electric Company, Atlanta, to succeed **Mr. P. S. Arkwright,** who has been elected president of the Georgia Railway & Power Company, lessee of the Georgia Railway & Electric Company.

Mr. Elmer Lingard has been appointed superintendent of electric lines of the United Electric Light & Water Company, Norwalk, Conn., to succeed Mr. Chester J. Ryan, who has resigned to engage in the contracting business. Mr. Lingard is a graduate of the Drexel Institute of Philadelphia.

Prof. R. G. Dukes, of the department of applied mechanics of Purdue University, delivered a lecture before the students and faculty of the College of Engineering of the University of Illinois on April 25, the subject being "Recent Discoveries in Physical Science and Their Bearing on Engineering Problems."

Mr. E. G. Connette, who recently resigned as transportation engineer of the New York Public Service Commission for the First District to re-enter railroad work, as noted in these columns April 20, has been appointed vice-president and general manager of the International Traction Company, of Buffalo, N. Y.

Mr. F. I. Fuller, vice-president of the Portland Railway, Light & Power Company, Portland, Ore., who has been connected with the company twenty years, was the guest of honor at a recent entertainment given by the employees of the company and was presented with a gold watch and fob by the employees as a token of esteem.

Miss O. A. Bursiel, secretary of the New England Section of the National Electric Light Association, was presented with a purse of gold at the office of the organization in Boston on May 4 in recognition of her services on behalf of the Luncheon Club branch in New England and in anticipation of her forthcoming trip to the Seattle convention.

Mr. Morton Ramsdell, who was for some years manager of the Seattle-Tacoma Power Company, owner of Snoqualmie Falls, has been appointed sales manager of the Seattle division of the Puget Sound Traction, Light & Power Company, to succeed **Mr. H. M. Winter,** who resigned to enter the real estate business in Seattle and Portland.

Mr. Robert C. Leonard has succeeded **Mr. A. Larney** in charge of the new-business department of the Oklahoma Gas & Electric Company at Oklahoma City, Okla. Mr. Larney is now stationed at St. Paul, another of the Byllesby properties, as new-business manager for the Consumers' Power Company, which operates in a number of the Northwestern States.

Mr. Jacob Furth, president of the Puget Sound Traction, Light & Power Company, has returned to his desk in Seattle from California, whither he went two months ago in search of rest and health. This company is the one now controlling the various railway and lighting properties managed by Stone & Webster in Seattle, Tacoma and other Puget Sound cities in the Pacific Northwest.

Mr. Horace W. King, who has been hydraulic engineer with the Arnold Company of Chicago, has been appointed professor of hydraulic and irrigation engineering at the University of Michigan. Mr. King graduated at Ann Arbor in 1895 and he has had a wide experience, having been with the Arnold Company for the last three years, paying particular attention to hydroelectric developments.

Dr. E. P. Hyde, director of the physical laboratory of the National Electric Lamp Association, Cleveland, sailed from New York on the *Mauretania* May 8 for a five weeks' trip to Europe. Dr. Hyde will visit the various standardizing and testing laboratories of Europe and while abroad will act as the official representative of the American Gas Institute and the Illuminating Engineering Society, of which latter body he is a past-president.

Mr. Robert H. Marriott, general superintendent of construction and maintenance of the United Wireless Telegraph Company, New York, delivered an address on May 4 before the Ohio State University Association of New York on wireless-telegraph service from vessels, in which special emphasis was placed on the necessity for regulation to prevent the loss of life or property, to facilitate business transactions and to aid the government in times of peace or war.

Mr. James R. Cravath, consulting engineer and manager, of Chicago, has moved his office from Suite 1570 Old Colony Building to Suite 1160 in the same building, owing to his need for increased space and facilities. Although he still retains a connection with the *Electrical World* as a special contributor, most of his time will be devoted to illuminating engineering and central-station management. Formerly Mr. Cravath was Western editor of the *Electrical World*, a position which he held for ten years. During this period he gave much study to central-station problems in communities of less than 10,000 population, and he is now managing several central-station properties in such cities.

Mr. R. T. Gunn, who has been appointed general superintendent of the Norfolk and Portsmouth and Norfolk and Ocean View divisions of the railway department of the Virginia Railway & Power Company, Richmond, Va., was formerly vice-president and general manager of the Eastern Wisconsin Railway & Light Company, Fond du Lac, Wis., and of the Wisconsin Electric Railway, Oshkosh, Wis. Before becoming connected with those companies he was superintendent of transportation of the Fort Wayne & Northern Indiana Traction Company, Fort Wayne, Ind., and previous to that was general manager of the Lexington Railway & Light Company, Lexington, Ky. Before becoming connected with the Lexington Railway & Light Company he was superintendent of the Norfolk Railway & Light Company, Norfolk, Va., which is now included in the system of the Virginia Railway & Power Company.

Mr. George W. Cravens, president of the recently established Cravens Electric Company, Chicago, has been engaged in the engineering, manufacturing and selling divisions of the electrical business since 1893, when he was first employed by the General Electric Company at Lynn, Mass. During the fourteen years he was with that company Mr. Cravens worked on every class of apparatus made by it, excepting steam turbines, either as designer, department foreman or engineer. Since going to Chicago, in 1907, he acted as engineer for the Goodman Manufacturing Company, maker of electrical coal-mining machinery, for two years, then independently as a consulting engineer for one year, specializing on isolated power plants and industrial betterment, and during the last two years he has been engineer for the Delta-Star Electric Company, having charge of the design and manufacture of its entire line of electrical devices. Mr. Cravens has been a frequent contributor to the technical press on electrical and manufacturing matters. He is an associate of the American Institute of Electrical Engineers.

Mr. H. S. Cooper, who was elected permanent secretary of the Southwestern Electrical and Gas Association at the recent meeting of that association at San Antonio, Tex., was formerly general manager of the Galveston (Tex.) Electric Company. Mr. Cooper has long been identified with electrical developments and is well known in the East. He was born in the Isle of Wight, England, in 1856. His first commercial connection was with a mercantile house in Philadelphia. In 1876 he began the manufacture of agricultural machinery in the South and in this way came into touch with electrical enterprises. In 1893 he was appointed general manager of the Schenectady properties of the Electric Development Company, which consisted at that time of the electric and gas-lighting and the railway services of the city, all of which were then in the hands of a receiver. In 1895 the properties were sold under foreclosure and then reorganized and placed on a paying basis by Mr. Cooper. Subsequently Mr. Cooper directed the rehabilitation of the Ithaca (N. Y.) Railway and placed that property on a paying basis. Later he became connected with the Development Company, New York, N. Y., and made critical reports on various kinds of electrical propositions for the clients of this company. In July, 1904, he accepted the position of general manager of the Galveston City Railway and continued with that company and its successor, the Galveston Electric Company, until 1910.

Mr. Samuel G. McMeen, member of the engineering firm of McMeen & Miller, of Chicago, has been elected president of the Columbus Railway & Light Company, of Columbus, Ohio. The Columbus Railway & Light Company operates all the electric traction and lighting properties of the Columbus Edison Company, the Columbus Light, Heat & Power Company, the Columbus Traction Company and the Columbus Railway Company. Mr. McMeen's new connection is regarded as a promotion from the presidency of the Mount Hood Railway & Power Company, of Portland, Ore. Mr. McMeen remains a partner in the firm of McMeen & Miller, of which he has been a member since its organization, although he has spent much of his time of late years on the Pacific Coast, in San Francisco, Los Angeles and Portland, in upbuilding or reporting on public-service properties. He is a member of the American Institute of Electrical Engineers, and, happening to be in his home town during the Chicago convention of last year, took an active part in its deliberations. Mr. McMeen rejoices in the further distinction of being the youngest-appearing grandfather in electrical circles.

SAMUEL G. M'MEEN.

Mr. Fred M. Lege, Jr., who was elected president of the Southwestern Gas and Electrical Association at its convention at San Antonio, Tex., April 27, is general manager of the Brush Electric Company, of Galveston, Tex., which does the local central-station business. Mr. Lege removed to Galveston in this capacity in 1907, and during the last two years has served also as general manager of the Galveston Gas Company, administering the affairs of both companies. The electric company recently passed to the control of the Doherty interests, Mr. Lege continuing as manager. Before taking charge of the Galveston properties Mr. Lege was sales engineer for the Allis-Chalmers Company in charge of steam and electric apparatus for the United States and Mexico, his headquarters during these three years being at El Paso, Tex. From 1903 to 1905 Mr. Lege acted as general superintendent of the Beaumont (Tex.) Ice, Light & Refrigeration Company, following a connection with the Tuggle Electric Supply & Construction Company, of Beaumont. From 1900 to 1901 he managed the Texas-Mexican Electric Light & Power Company, of Eagle Pass, Tex. Mr. Lege was one of the founders of the Southwestern association which recently honored him by election as its president. He is also an associate member of the American Institute of Electrical Engineers and a member of the National Electric Light Association and the Sons of Jove.

FRED M. LEGE, JR.

Obituary

Mr. Pedro Juan Rosaly, formerly president of the Ponce Railway & Light Company, Ponce, Porto Rico, is dead. Mr. Rosaly of late years had devoted his time very largely to the business of Luce, Crehore & Company and to the Ponce Railway & Light Company.

Construction

JACKSON'S SHOALS, ALA.—The plant of the Alabama Pwr. Development Co., which has been under construction here for some time, is now nearing completion.

PHOENIX, ARIZ.—The Salt River Valley El. Ry. Co. has started grading on its new interurban electric railway that is to run from Phoenix, Ariz., through the Salt River valley for a distance of 35 miles. It will connect the towns of Scottsdale, Tempe and Mesa with this city.

TUCSON, ARIZ.—It is reported that plans have been prepared by the Tucson Gas, El. Lt. & Pwr. Co. for extensions of the street railway and gas mains to new sections of the city.

CONTRA COSTA, CAL.—R. E. Bonsfield, Berkeley, Cal., has been awarded a franchise by the Board of Supervisors to build an electric railway in the southern part of Contra Costa County.

EL PORTAL, CAL.—The Merced River El. Co. has begun work here on a power station.

LOS ANGELES, CAL.—City Engineer Hamlin has passed a recommendation that plans be made as a preliminary step toward the installation of a municipal power station.

ORANGE, CAL.—The Pacific El. R. R. Co. is planning for the construction of an electric line through Orange, connecting the Santa Ana line with the La Habra line. A right-of-way has been asked from Main Street, Santa Ana, to the south end of Lemon Street, Orange, and from the north end of Lemon Street to the Southern Pacific tracks, to the north of Orange.

ORO, CAL.—The Oro El. Corpn. has issued $3,500,000 in bonds, the proceeds from which will be used in increasing the capacity of its hydroelectric plants and in making other improvements to its various properties.

PALO ALTO, CAL.—A municipal election will be held here on May 20 to vote on the issuance of $67,000 in bonds for certain municipal improvements. Of this amount $12,000 will be expended for an electric generating set.

SACRAMENTO, CAL.—The work of installing electroliers on the principal streets of the city has been started. Considerable electrical work is now being done by the city.

SAN FERNANDO, CAL.—The Pacific Electric Ry. Co. has begun work on its extension to San Fernando, and by July 1, 1912, cars will be running from this city to Los Angeles, a distance of about 20 miles.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Pwr. Co. has applied for franchises to construct a transmission line from Alviso to Salinas, Cal., a distance of about 55 miles. The company expects to furnish power to the towns of Morgan Hill, Gilroy and other places in San Benito County, Cal.

SAN MATEO, CAL.—The United Railroads is considering several extensions in this city.

SANTA ROSA, CAL.—The Great Western Pwr. Co. has begun placing poles in preparation for supplying energy in this vicinity.

STEAMBOAT SPRINGS, CAL.—A. M. Gooding and associates have applied to the City Council requesting a franchise for an electric-light plant. They plan to erect a station on Fish Creek and extend their lines to this city, Hayden and other neighboring points.

TULARE, CAL.—A map filed here with the city clerk shows the various streets upon which it is proposed to run electric wires, under the franchise owned by C. W. Rogers, of New Valley.

TULARE, CAL.—L. B. Davis, of Tulare, engineer for the Tulare Pwr. Co., states that this company is now working on a hydroelectric plant of 3000 hp in the Sierra Nevada Mountains, and expects the work to take a year.

COLORADO SPRINGS, COL.—Property owners in the business section have signed a petition for a decorative street-lighting system.

DENVER, COL.—Bids will be received until May 20 by William F. Burchinell, Secretary State Board, Capitol, for electric storage batteries for the State Capitol. F. E. Edbrooke, architect, 512 Opera House Block.

LA JUNTA, COL.—An ornamental street-lighting systetm is to be installed here.

LOVELAND, COL.—The City Council has the question of an ornamental lighting system under consideration.

DANIELSON, CONN.—The committee on street lights has recommended that improvements be made to the local lighting system.

WESTPORT, CONN.—The United El. Lt. & Wtr. Co., which is the New York, New Haven & Hartford R. R.'s light, power and water corporation, has purchased the Westport Wtr. & El. Co. and will discontinue the manufacture of electricity at the local plant, securing electricity for local needs from its Norwalk plant.

WILMINGTON, DEL.—Representatives of the Public Utilities Lt., Ht. & Pwr. Co. have been inspecting sites in this city with a view to erecting a power station.

WASHINGTON, D. C.—Bids will be received by the Isthmian Canal Commission not later than 10:30 o'clock a. m. on May 20, 1912, for electric cable, wire, fuses, sockets, plugs, dry cells, carbon, etc. A circular (No. 707) giving specifications for this material may be obtained from the offices of the commission at Washington, D. C.; from the offices of the assistant purchasing agents at 24 State Street, New York City; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal., and also from the United States engineering offices in the most of the large cities throughout the country.

BLOOMINGTON, ILL.—A contract for erecting twenty-six ornamental lamp standards on South Center Street has been let to Guy Carlton, of Bloomington.

BONDVILLE, ILL.—Charles Barker, B. A. Bruder and Jesse M. Young are members of a committee to investigate the feasibility of establishing an electric-light plant here.

ELGIN, ILL.—Sealed bids will be received at the office of the board of administration, State Capitol Building, Springfield, Ill., up to 11 a. m. May 20, 1912, and then publicly opened, for equipping the water works of the Elgin State Hospital, Elgin, Ill., with motors, triplex pumps, centrifugal pumps and other electrical supplies. Specifications can be seen at the hospital, or can be obtained upon application to Frank D. Whipp, fiscal supervisor, Springfield, Ill.

EL PASO, ILL.—The factory of the Prairie State Canning Co., which is being erected here, will be equipped for motor drive.

FULTON, ILL.—The plant of the Fulton Electric Lt. & Pwr. Co. is reported to have been transferred to the Public Service Co. of Chicago, and it is said that the new owners will increase the capacity of the plant and install new machinery.

GILLESPIE, ILL.—C. A. Ramsey and J. J. Frey, of Hillsboro, Ill., and J. E. Hitt and R. R. Hammond, of Chicago, have purchased the plant of the United El. Lt. & Pwr. Co. here. The new owners will build a transmission line from their plant at Hillsboro and dismantle the plant at this place.

MOLINE, ILL.—A petition has been presented to the City Council asking for a franchise for the Tri-City Automatic Home Tel. Co.

PONTIAC, ILL.—R. A. Morrison is chairman of a committee which inspected ornamental light standards at Bloomington with a view of installing a similar system here.

ROBINSON, ILL.—The plant and all rights and franchises of the Robinson Wtr., Lt. & Ht. Co. will be sold May 23 at the office of the receiver, W. H. Clinton, in this city, pursuant to an order of the federal court at Danville. Bids under $100,000 will not be considered.

HANOVER, IND.—The Madison Lt. & Ry. Co. is reported to be considering the furnishing of electricity to Hanover, the energy to be transmitted a distance of 8 miles.

INDIANAPOLIS, IND.—It is reported that F. Hilgemier & Co. will receive bids for furnishing and installing two 150-hp boilers with automatic stokers and for the construction of a brick smokestack, 125 ft. high, in their plant on Raymond Street.

INDIANAPOLIS, IND.—The committee representing the commercial organizations of this city, appointed to consider the proposed merger of the Indinanapolis and the Central Union telephone companies, has decided to recommend that such merger be effected.

INDIANAPOLIS, IND.—It is reported that the Cincinnati, Hamilton & Dayton R. R. Co. will receive bids for the construction of a new power plant on the site of the Mooreville round house, Indianapolis, and also for the installation of three boilers of 150 hp, automatic chain-grate stokers and the erection of a 125-ft. concrete smokestack.

MICHIGAN CITY, IND.—The contract for installing a boulevard lighting system in Franklin Street, consisting of 117 light posts and about 8000 ft. of underground wiring, has been awarded to W. E. Sheeler, of Michigan City, for $9,256.

PETERSBURG, IND.—The Cumberland Tel. Co. has been granted a 10-year franchise to operate a telephone system in this city.

BENNETT, IA.—The Council is reported to be considering the question of installing electric lights.

BLUFTON, IA.—John Mara, of Cresco, has secured property rights on the Upper Iowa River upon which, it is understood, a power station will be erected.

CEDAR BLUFF, IA.—A proposition to issue $8,000 bonds for building an electric-light plant for this town was carried at a special election held recently.

OAKLAND, IA.—The Oakland El. Co. is reported to have purchased a site for a power house.

OTTUMWA, IA.—A franchise has been granted to the Troy Canning Co., giving it the right to conduct and operate an electric-light plant for the period of 25 years. Work is to be started immediately.

SHARPSBURG, IA.—The Lee El. Co., of Clarinda, is reported to have petitioned Council for a franchise.

NEWTON, KAN.—The Kansas Gas & El. Co. has completed plans for the rebuilding of its power plant here. Additional energy, which will be available when these improvements are made, will be used upon the interurban line which is proposed to build north of here.

FRANKFORT, KY.—The Kentucky Public Service Co. is planning the construction of a new power house here. It recently took over the plant of the Capital Gas & El. Lt. Co. and, in keeping with its general plan of improving its properties, will make many betterments at Frankfort.

JEFFERSONTOWN, KY.—Arrangements have been practically completed by the Louisville Ltg. Co. for extension of its lines to Jefferson-

town, Ky., where a large number of residents have agreed to install the service. The Jeffersontown Commercial Club is co-operating with the company.

LOUISVILLE, KY.—The Booker Box Co. is in the market for electric motors. S. E. Booker is president of the concern.

MARION, KY.—The Marion El. Lt. & Ice Co., of Marion, Ky., is considering enlarging its plant on account of the amount of motor business which had been offered it. A new flour mill, which is to be erected here, is now negotiating for energy. The company will probably issue bonds to finance the improvements.

NEWPORT, KY.—The city engineer has drawn plans for what is known as boulevard lighting on the following streets: York from Third to Eighth, Monmouth from Third to Eleventh, Third from York to Saratoga, Sixth from York to Monmouth, and Eighth from Columbia to Monmouth. The lights are to be 70 ft. apart. Under a resolution adopted by the City Council, the Union Lt., Ht. & Pwr. Co. has been asked to submit an estimate of the cost of installing the system and operating it. A proposition had already been received from the company that the city place an order for the system and pay 20 per cent of the cost each year for five years. Business houses which will be benefited by the proposed system will be asked to aid in paying the cost of the system and maintaining it.

AUGUSTA, MAINE.—Improvements to the street-lighting system of the city are being contemplated. Objections to the present system are that there is no uniformity in the method of stringing lamps throughout the city, some lights being hung low on one side of the street and high on the other. It is possible that the authorities will adopt the cluster system.

ANDOVER, MASS.—The Willimantic Gas & El. Co. is considering extending its lines to this place.

EAST LONG MEADOW, MASS.—At a public hearing last week on the petition of the Central Massachusetts El. Co., of Palmer, for authority to locate poles in East Long Meadow, those present voted in favor of the proposition.

HAVERHILL, MASS.—The Haverhill El. Co. has submitted several propositions to the Municipal Council for lighting the streets. The arc lights, for which the present contract expires Nov. 1, cost $100 per light per year, whereas under a five-year contract they will cost $91.20, and under a 10-year contract $86.40. The company offered to install incandescent lamps in several places where there are now gas and naphtha lamps, one proposition being to have the incandescent lamps burn all night.

LOWELL, MASS.—The power station of the Lowell Textile School is rapidly approaching completion.

LOWELL, MASS.—The Lowell El. Lt. Co. and the Lowell Gas Lt. Co. are each reported to be planning to construct a system of ornamental poles, etc.

SALEM, MASS.—The Council is reported to be considering an appropriation of $20,000 for installing electrical apparatus in the new electric department building to be erected in connection with the new police station and court building.

STONEHAM, MASS.—The Board of Selectmen has signed a 10-year contract with the Edison Illumg. Co. of Boston for the lighting of municipal buildings, streets and residences.

WORCESTER, MASS.—The street-lighting committee of the Merchants' Association has been inspecting the lighting systetms of New Haven and Hartford, Conn., with a view to getting data for improving the lighting system of this place.

DETROIT, MICH.—The Edison Illumg. Co. has awarded the general contract for the six-story and basement power house, 116 ft. x 96 ft., to A. A. Albrecht, 820 Penobscot Building, Detroit, for about $125,000.

HOLLAND, MICH.—A report of a consulting engineer in regard to the proposed $26,000 improvements to the city lighting plant has been submitted to the Town Council.

NORTH ADAMS, MICH.—Claire Allen, 24 Dwight Building, Jackson, is reported to be preparing plans for a new power house, 51 ft. x 36 ft., for North Adams. Cost, about $25,000.

OLIVET, MICH.—Representatives of the Commonwealth El. Lt. Co. have been in this place recently getting permission to erect poles for the purpose of extending their lines from Charlotte to Battle Creek, and towns between these two places will probably be supplied with energy within four or five weeks.

GILBERT, MINN.—A special committee of the Commercial Club has been appointed to confer with the Town Council relative to improving the street lighting in this township.

HOWARD LAKE, MINN.—H. G. Rutledge, of the Glencoe El. Lt. Co., of Glencoe, is reported to have petitioned for a franchise to erect and operate an electric light plant here and to transmit electric energy to Dassel and Cokato.

LAKE CRYSTAL, MINN.—The Village Council has granted a 25-year franchise to the Consumers' Pwr. Co. and entered into a five-year contract for lighting.

TOWER, MINN.—Additional consumers are being connected very rapidly to the mains of the municipal hydroelectric plant here. It is reported that the government Indian School is desirous of obtaining energy from the city plant and that this is being considered by the city authorities.

GREAT FALLS, MONT.—The Lewiston El. & Pwr. Co. will begin work on the power line between Lewiston and Great Falls at once. The distance is about 120 miles and the cost will be about $250,000. F. M. Kerr, Lewiston, Mont., is general superintendent of the company.

CAMDEN, N. J.—An ordinance authorizing a bond issue of $300,000 for the erection and operation of a municipal lighting plant has been adopted.

NEWTON, N. J.—F. O. Runyon, of Newark, is reported to be preparing estimates for a municipal electric-light plant.

DEMING, N. M.—The Deming Ice & El. Co. is constructing an electric transmission line from its plant here to a number of irrigating pumping plants in the Mimbres Valley. It will build about 30 miles of electric transmission lines during the next few months.

CHARLOTTE, N. Y.—Negotiations have reached the point where it is thought an agreement will be made between the village officials and those of the Rochester Ry. & Ltg. Co., whereby the lighting company will supply all of the electricity needed for the village illumination. A municipal lighting plant and water-works have been in operation in this town for a number of years in one of the summer residential districts, but have been a source of public nuisance owing to the smoke and the heavy traffic made necessary by the carting of coal.

ELMIRA, N. Y.—The Elmira Wtr., Lt. & R. R. Co. (H. M. Beardsley, manager) is reported to have purchased a site on East Water Street and will have plans prepared at once for a power plant.

LONG LAKE, N. Y.—It is reported that an electric-light company has been organized to furnish the village with electrical energy from water-power sites here.

ONEIDA, N. Y.—The city of Oneida has entered into a contract with the Adirondack El. Pwr. Corpn. for lighting the city for the term of 4 years and 11 months.

BURLINGTON, N. C.—The Alamance Pwr. Co. is reported organized to build a hydroelectric plant to develop the water-power at River Falls on the Haw River in Alamance County, near Burlington. It is proposed to issue $300,000 bonds in connection with the proposition soon. The officers are: F. L. Williamson, president, Burlington; J. Harvey White, vice-president, Graham, N. C.; Charles E. Menefee, secretary, Burlington.

COLUMBUS, OHIO.—E. W. Clark & Co., Phi'adelphia, have taken control of the Columbus Ry. & Lt. Co. Samuel G. McMeen, formerly president of the Mount Hood Ry. & Pwr. Co., Portland, Ore., has been elected president and director, succeeding R. E. Sheldon.

DEFIANCE, OHIO.—The plant of the Auglaize Power Co., which is being constructed here, is nearly completed.

NEWARK, OHIO.—A. H. Heisey has taken over the plant and business of the Newark Ht. & Lt. Co., of which he owned a majority of the stock, and hereafter it will be operated as a private concern. It is stated that the change will not affect the patrons of the company.

NEWPORT, OHIO.—The local authorities and business interests are promoting the installation of boulevard lighting at this place.

NORWOOD, OHIO.—The Board of Public Service is reported to be considering the issue of $100,000 bonds to overhaul and re-equip the electric-light plant and water works.

OKLAHOMA CITY, OKLA.—The Oklahoma Pwr. & El. Co. is reported to have selected Croslen & Chappelle, 804 Colcord Building, to prepare plans for the erection of a power plant to cost $1,500,000 and to be located 10 miles from Durant. The plant will have a capacity for developing 100,000 hp., and the company will use the consumers' gas made at its own mines. The company will install steam turbines of from 8000 hp to 12,000 hp each. It is contemplated to transmit the electricity to Fort Worth, Dallas, Oklahoma City, Little Rock, Texarkana and, in fact, to all the principal cities in three States.

VALE, ORE.—The Idaho-Oregon Lt. & Pwr. Co. has been granted a franchise to operate here.

MANAYUNK, PA.—Plans are in progress for installing better lighting facilities along the principal streets of this town.

PROVIDENCE, R. I.—The Woonsocket Gas Co., the Woonsocket El. Machine & Pwr. Co., and the Pawtucket El. Lt. Co. have been merged into one corporation known as the Blackstone Valley Gas & El. Co.

McCOLL, S. C.—The Town Council has granted a franchise to P. D. Parish, of Cleo, to supply electric current in this town. Energy will be transmitted from a plant operated by Mr. Parish on the Pee Dee River. Additional equipment will be installed at this plant in order to meet the increased demand upon it.

HETLAND, S. D.—Negotiations are in progress for extending transmission lines from Lake Preston to this place with a view to supplying electricity to the various streets and buildings.

CHATTANOOGA, TENN.—The Retail Merchants' Association is promoting a movement for the installation of an extensive lighting system on a number of streets here.

CLARKSVILLE, TENN.—Montgomery, Clothier & Tyler, of Philadelphia, have purchased the holdings of the Clarksville Ry. & Lt. Co. and those of the Clarksville Gas Co. These are the same interests, it is understood, that recently purchased public utility properties at Hopkinsville, Bowling Green, Owensboro, and Frankfort, Ky.

GALLATIN, TENN.—The new municipal electric light plant of Gallatin, Tenn., has been put in operation.

KNOXVILLE, TENN.—Congress has been petitioned for the privilege of constructing two dams on the Clinch River, Tenn., by the Tennessee Hydro-Electric Pwr. Co. The company intends to erect a water-power plant there and on the Powell River. It has a capital stock of $100,000, and stockholders include J. R. Paul, a Pittsburgh banker; Gen. James P. Cox, of Knoxville, and F. M. Butler and others, of Clinton, Tenn., the company's incorporation having been made there, as previously noted in these columns.

LENOIR, TENN.—The Lenoir Lt. & Pwr. Co. has arranged to receive energy for the operation of its plant from the Ocoee River station of the Tennessee Pwr. Co. H. C. Foster is general manager of the company.

SPARTA, TENN.—A contract will probably be let in about 60 days for construction of plant for the A. & T. Pwr. Co., to cost about $10,000.

COPPERAS COVE, TEX.—George Walker, of San Gabriel, Tex., is preparing to install an electric-light plant and ice factory at this place.

DALLAS, TEX.—City Electrician Taylor is reported to have been instructed to prepare estimates, etc., for a municipal light plant.

HOUSTON, TEX.—The Houston El. Co., of Houston, will extend its street-railway system through the northern part of the Magnolia Park suburb.

STOCKDALE, TEX.—V. B. Colby, of Smiley, Tex., will install an ice factory and an electric-light plant here.

SYLVAN BEACH, TEX.—William C. Clark is preparing to install an electric power and lighting plant here. Transmission lines will extend to La Porte, Bay Ridge, and Morgan's Point for the purpose of supplying those towns with energy.

WACO, TEX.—Local press reports state that Henry M. Bailey, of New York, N. Y., with offices now in the Amicable Building, Waco, will have charge of the construction work of the power plant to furnish power for the cars of the Southern Traction Co. and also light and power within a radius of 50 to 75 miles, with Waco as the center.

SALT LAKE CITY, UTAH.—The City Commission is considering the granting of a franchise to the Merchants' Lt. & Pwr. Co., of Ogden, giving that concern the right to operate in Salt Lake City for 50 years.

ST. ALBANS, VT.—The property of the St. Albans Street Ry. Co. here, in St. Albanstown and Swanton has been sold to Walter R. Dame, of Clinton, Mass., who, it is understood, represents Massachusetts interests whose names are not given. It is stated that the improvements contemplated by the former owners will be given consideration.

FRIES, VA.—The hydroelectric development of the Appalachian Pwr. Co., near here, is rapidly approaching completion.

CENTRALIA, WASH.—The Washington-Oregon Corporation has been granted a franchise by the Lewis County Commissioners to build a power line from Chehalis, Wash., to the south limits of Lewis County.

NORTH YAKIMA, WASH.—The Pacific Pwr. & Lt. Co. has applied for a county franchise over several roads in the county and will make extensions in its transmission lines.

SEATTLE, WASH.—Bids will be received until May 31 by Capt. J. R. Pourie, Constructing Quartermaster, U. S. A., 482 Arcade Annex, Seattle, for constructing a substation and transmission line and furnishing a rotary converter, transformers, wattmeters, etc., at Fort Worden and Fort Flagler, Wash. Bids will be received same time and place as above for constructing an electric lighting system, furnishing and installing fixtures and wire for buildings, also a pump with direct-connected motor complete at Fort Ward, Wash.; also constructing an electric-lighting system and pumphouse with motor-driven pump, installing fixtures in buildings and delivering certain electrical apparatus at Fort Casey, Wash.

SOUTH BEND, WASH.—The city is contemplating the installation of a cluster street-lighting system along the main business street.

BALSAM LAKE, WIS.—A franchise is reported to have been granted to Harry D. Baker, of St. Croix Falls, Wis., to operate an electric-light and power plant.

BAKERVILLE, B. C., CAN.—The Antler Goldfields & Devel. Co., Ltd., has been organized with a capital stock of $1,000,000. The company proposes to erect a large hydroelectric power plant at the junction of the Antler and Russian Creeks.

DUNCAN, B. C.—The city is contemplating the installation of a municipal light and power plant.

BROCKVILLE, ONT., CAN.—The freeholders of Brockville have voted to enter into a contract with the Ontario Hydro-Electric Commission for a supply of energy.

MARKHAM, ONT., CAN.—Engineer Acres, of the Hydro-Electric Commission, Toronto, is reported to be here, looking into the feasibility of building one or two dams on Rouge River, below Markham, to generate power for flour and other mills.

PRINCE ALBERT, SASK., CAN.—The Ambursen Hydraulic Const. Co. is reported to have submitted to City Council a proposition to build dam and headworks for the Lacolle Falls power scheme.

CANANEA, SONORA, MEXICO.—The Calumet & Sonora property near here will spend $100,000 in new electrical equipment.

MEXICO CITY, MEXICO.—C. F. Karnes has made application to the federal government for a concession to install a hydroelectric plant in the territory of Tepic.

New Industrial Companies

THE ELECTRICAL ENGINEERING & SUPPLY COMPANY, of Stockton, Cal., has been granted a charter with a capital stock of $25,000. The incorporators are: A. F. Flanagan, B. F. Wellington and Henry Adams.

THE FARADAY COMPANY, of New Haven, Conn., has been incorporated with a capital stock of $10,000 for the purpose of doing an electrical business. The incorporators are: Camillo Torto, Carmine Dogastino and Louis O. Yeomans, all of New Haven, Conn.

THE MAGNETO-DYNAMOTOR CO., of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture and deal in machinery, motors, etc. The incorporators are G. L. Henry, F. B. Moody and B. T. Moody, New York, N. Y.

THE A. E. PRICE COMPANY, of Champaign, Ill., has been incorporated with a capital stock of $10,000 to manufacture and deal in electrical supplies and appliances and electrical signs. The incorporators are: J. W. Price, C. R. Iungerich and A. E. Price.

THE W. ROBERTSON MACHINE & FOUNDRY COMPANY, of Buffalo, N. Y., has been organized under the laws of New York with a capital of $15,000 to manufacture machine tool specialties. The officers are: W. Robertson president and manager; T. J. Reed, vice-president; F. H. Keil, secretary; F. M. Robertson, treasurer. The offices of the company are at 32 Greenwood Place, Buffalo, N. Y.

New Incorporations

LOS ANGELES, CAL.—The American Pwr. Co. has been incorporated with a capital stock of $2,000,000. The directors are N. O. Harmon, Henry Waterman and S. J. Powell.

SAN FRANCISCO, CAL.—The Sacramento Valley El. Ry. Co. has been incorporated with a capital stock of $5,000,000. The directors are J. A. Jacobs, A. H. Beamer and E. I. Brink. The principal place of business will be at San Francisco.

DENVER, COL.—The Bellview Consolidated Lt. & Pwr. Co. has been incorporated here, with a capitalization of $2,500,000. F. H. Potter, J. E. Lightbourn and E. W. Williams, all of Boulder, Col., are the incorporators.

GENEVA, GA.—The Geneva Pwr. Co. has been incorporated with a capital stock of $8,000 for the purpose of building an electric plant by D. O. Vaughan and others.

CHICAGO, ILL.—The Dolly El. Specialty Co., of Chicago, has been incorporated with a capital stock of $9,000, to manufacture automobile electric supplies. The incorporators are Edward W. Dolliver, William M. Pearl and Wilbert A. Fechtman.

PORT BYRON, ILL.—The Rock River Pwr. Co. has been incorporated with capital stock of $2,500 to construct a dam across Rock River and maintain a power plant in connection therewith. The incorporators are Owen T. Smith, Paul G. and George M. Clark and George F. Bunn.

WASHBURN, ILL.—The Washburn Tel. Co., of Washburn, Ill., has been incorporated with capital stock of $2,000 to operate a telephone exchange. The incorporators are Oscar Shepard, C. E. Spangler, and John Jaquot.

LOUISVILLE, KY.—The Interstate Pwr. Co. has been incorporated with a capital stock of $100,000 by J. C. Loomis, T. K. Helm and R. J. Snyder. The company proposes to generate and distribute electricity in small towns in eastern Tennessee in the Appalachian district.

FAIRFIELD, MAINE.—The Pettee's Pond Pwr. Co. has been organized for the purpose of generating and selling gas and electricity for light and power purposes in the towns of Benton, Clifton, Winslow, Vassalboro, Oakland, Fairfield and Skowhegan, and the cities of Waterville and Augusta. The incorporators are John P. Clark, of Skowhegan, president, and Clyde H. Smith, of Skowhegan, treasurer. These two and Amos F. Gerald are directors.

HARDIN, MONT.—The Big Horn Canyon Irrig. & Pwr. Co. is reported incorporated, with a capital of $5,000,000, by John J. Harris and Anton Beecher, of Hardin, and B. C. Lillis, of Billings, and others, to build a dam about 130 ft. high over Big Horn River at the mouth of the Big Horn Canyon, to irrigate land on both sides of the river, besides running an electric power plant.

JEFFERSONVILLE, N. Y.—The Sullivan County R. R. Co. has been incorporated with a capital stock of $200,000 by W. Kohler, Jeffersonville; L. H. Brown and H. B. Mingle, New York. The company proposes to build an electric railway from Liberty to Jeffersonville, via Sulphur Springs and Youngsville, a distance of 14 miles.

FRANKLIN, PA.—The Franklin Pwr. Co. has been granted a charter with a capital stock of $5,000 to operate in Franklin Township. The incorporators are: W. B. Crawford, J. S. Monroe, of Pittsburgh, and L. B. Custer, Wilkinsburg.

KNOXVILLE, PA.—The People's El. Co., of Knoxville, is reported incorporated with a capital of $5,000 by A. P. Weitzel, Frank Nichol and S. G. Nolan, of Pittsburgh.

LANCASTER, PA.—Charters have been granted to five electric companies to operate in Lancaster County, at Lancaster. The capital of each is $5,000, and the incorporators are W. W. Griest, C. E. Titzel and John S. Graybill, Jr., Lancaster. The companies and the districts where they are to operate are Christiana, Leacock Township, Sadbury Township, Salisbury Township and Paradise Township.

MOUNT OLIVER, PA.—The Mount Lebanon El. Co., of Mount Lebanon, has been incorporated with a capital of $5,000 and office at Mount Oliver, by Walter N. Rainbow, of Leetsdale; C. A. Lambie, of Glen Osborne and W. W. Murray, of Bridgeville.

NORRISTOWN, PA.—A charter has been granted to the Norristown Pwr. Co., of Norristown, with a capital of $10,000, to supply light, heat and power by means of electricity within the township of Norristown. Incorporators: Samuel L. Kent, Walter L. Rogers, John D. Murphy and others.

GALLATIN, TENN.—The Cumberland Valley & Interstate El. Ry. Co. has been incorporated with a capital stock of $50,000 to construct an interurban railway from Gallatin to Stanford or Danville, Ky. The incorporators are: Harris Brown, S. M. Young, E. S. Payne, W. Y. Allen, P. F. Burnley and others.

MURFREESBORO, TENN.—The Murfreesboro El. Ry. has been granted a charter for the construction of an electric railway from Clarksville to Woodbury, via Nashville, Springfield and Murfreesboro. The company is capitalized at $50,000 and the incorporators are: R. T. Wilson, Joseph Frank, R. L. Burch, T. Garland Tinsley and Albert F. Lee.

SALT LAKE CITY, UTAH.—The Whitmore El. Htg. Co. has been incorporated with a capital stock of $50,000. The officers are: A. O. Whitmore, president; Jenetta R. Whitmore, vice-president; Ernest M. Fowler, secretary, and William Charles Staines, treasurer.

SPANISH FORK, UTAH.—The Leland El. Lt. & Tel. Co. has been incorporated with a capital stock of $10,000. The officers are: Benjamin Isaac, president; Arthur Snow, vice-president, and Perry Thomas, secretary and treasurer.

PURCELLVILLE, VA.—The Loudoun Lt. & Pwr. Co. has been granted a charter with a capital stock of $5,000 to operate a light and power plant. The officers are: W. A. Cockey, Jr., president; M. N. Lyon, Rosslyn, Md., vice-president, and J. W. Gregg, Purcellville, secretary.

SEATTLE, WASH.—Articles of incorporation have been filed by the Seattle, Kenwood & Lake Forest Ry. Co. The capital stock is $400,000. An electric line will be built from Seattle to Kenwood, where the shops will be located, to Lake Forest and to Cherry Valley.

MORGANTOWN, W. VA.—The West Virginia Pwr. & Transmission Co. has been granted a charter with a capital stock of $50,000 for the purpose of developing hydroelectric power plants. The incorporators are: P. J. Crogan, Kingwood; Frederick W. Scheidenhelm, Gerard H. Matthews, Mellen C. Wiley and Harold A. Dunn, Connellsville, Pa.

HILLSBORO, WIS.—The Hillsboro Lt. & Pwr. Co. has been incorporated with a capital stock of $25,000 by F. W. Wopat, Wenzel Wopat, Fred Wopat, F. A. Machore and Edward Kuhn.

Trade Publications

BATTERY-CHARGING RHEOSTATS.—The General Electric Company's Bulletin No. 4934 is devoted to that company's battery-charging rheostats known as Type CR-211.

WALL SOCKETS.—Bulletin No. 83 of the H. T. Paiste Company, Philadelphia, Pa., covers a new line of wall sockets and rosette sockets similar to its regular key, keyless and pull types.

ORNAMENTAL LAMP-POSTS—The Paxton & Vierling Iron Works, Omaha, have issued an attractive catalogue of ornamental poles for street lighting, including combination lighting and trolley posts, wall brackets, etc.

TRANSFORMERS.—The Delta-Star Electric Company, of Chicago, Ill., is distributing a pamphlet in which are illustrated and described the high-voltage Pittsburgh transformers which have been supplied by this company for municipal street-lighting systems in Chicago.

DIRECT-CURRENT MOTORS.—In a bulletin recently issued by the General Electric Company (No. 4915) are described that company's Type CVC direct-current motors of the commutating-pole design. The motors described contain certain improvements over those described in the company's previous bulletin on this subject.

SMALL ALTERNATING-CURRENT SWITCHBOARD PANELS.—In a bulletin bearing the above title (No. 4944) the General Electric Company describes panels designed for use in isolated and small plants where the estimated capacity will not exceed 1500 kw. The bulletin contains connection and dimension diagrams of the panels described.

SMALL MOTORS.—Descriptive Leaflet No. 2441 issued by the Westinghouse Electric & Manufacturing Company is devoted to points of importance in the application of small motors. The various questions of mounting, method of drive and lubrication are discussed. Single-phase and direct-current motors are treated separately and a paragraph is devoted to heating.

SELF-STARTING SYNCHRONOUS MOTORS.—The Westinghouse Electric & Manufacturing Company has issued Descriptive Leaflet No. 2409, covering self-starting synchronous motors in capacity from 90 hp to 1500 hp and from 200 volts to 6600 volts. Various detailed views are shown of the component parts of this motor and descriptive matter related to the method of construction of each.

ALTERNATING-CURRENT MOTORS.—Type CA alternating-current motors, such as are used for operating washing machines, vacuum cleaners, food choppers, adding machines, sign flashers, house pumps and similar applications, are described and illustrated in Descriptive Leaflet No. 2362, issued by the Westinghouse Electric & Manufacturing Company. These motors are built in capacities of 1/20 hp to 1 hp, single-phase, 110-220 volts. Detailed views of the component parts of the motor are shown and descriptions given.

WATER-TUBE BOILERS.—The Keeler water-tube boiler is well described in a handsomely illustrated booklet published by the E. Keeler Company, Williamsport, Pa. The descriptions are accompanied by a number of illustrations, showing interiors of boiler rooms and details of boilers and their equipment. In one chapter the manufacturer presents arguments in favor of his product, discussing practically every detail and comparing them with those of other types. Ten tests of Keeler boilers are reported, including all the data.

ELECTRICAL EQUIPMENT FOR IRON AND STEEL MILLS.—The General Electric Company has just issued an elaborate bulletin devoted to the subject of electrical equipment of iron and steel mills. The bulletin, which has an attractive cover and is printed in two colors, deals with generating and transforming apparatus for steel-mill service, electrical distribution of power for steel plants, small mill-type motors for alternating-current and direct-current service, large alternating-current and direct-current motors for rolling-mill service, control equipments for steel mills, synchronous condensers for improvement of power-factor, and electric lighting of steel plants. The number of the bulletin is 4923.

ELECTRIC TRAIN CONTROL.—"Multiple Unit Trains and HL Control" is the title of a circular (No. 1522) issued by the railway and lighting department of the Westinghouse Electric & Manufacturing Company. As the title indicates, this publication deals with the type HL control manufactured by the Westinghouse company. The front cover has a view looking from the motorman's cab showing also the master controller, air brake, control apparatus, etc. In addition to describing the advantages of this type of control and showing illustrations thereof, the publication contains reprints of two papers, one on two-car train operation for city and suburban travel, read before the American Electric Railway Transportation and Traffic Association, Atlantic City, N. J., October, 1911, by Mr. C. J. Franklin, general superintendent Portland (Ore.) Railway, Light & Power Company, and the other on trailer operation versus multiple-unit trains, read before the Central Electric Railway Association at Cedar Point, Ohio, August, 1911, by Mr. Clarence Renshaw, engineer with the Westinghouse company.

Business Notes

THE SUNDH ELECTRIC COMPANY has moved its New York office from 113 Cedar Street to 548 West Twenty-third Street.

ESCHER, WYSS & COMPANY, of Zurich, Switzerland, have moved their Canadian office from Toronto to 514 Canadian Express Building, Montreal.

MR. H. McL. HARDING, consulting engineer for the design of terminal installations and freight-handling machinery, has moved his offices to the Whitehall Building, 17 Battery Place, New York, N. Y.

RIDGWAY DYNAMO & ENGINE COMPANY.—The New York office of the Ridgway Dynamo & Engine Company has been moved to 39 West Thirty-second Street. The main office and works of the company are at Ridgway, Pa.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York, has opened a branch store at 1106 Pine Street, St. Louis, Mo. This store will be under the direct management of Mr. F. M. Pierce, who is also the manager of the Chicago branch of this company.

THE JOHN T. SLACK CORPORATION has made important additions to the electric generating and motor equipments of the electrical department of its factory at Park and Factory Streets, Springfield, Vt. Mr. Slack is vice-president of the Springfield Electric Company.

DWIGHT & BOZELL, Oklahoma City, Okla., has employed the engineering firm of Dwight & Bozell, Norman, Okla., to make a study of the present arc and incandescent street lighting and to submit plans for relocating these units to secure better illumination and efficiency.

THE CRAVENS ELECTRIC COMPANY, which has been organized in Chicago with Mr. George W. Cravens as president, will bring out a general line of electrical devices for use in the automobile, industrial, lighting, mining, power-plant, railway and supply fields, but will specialize on the development of special devices and systems to meet specific demands. This company will also develop and market the inventions of others on a royalty basis and will act sa sales agent for various concerns making supply parts and materials. The principal office is in the Commercial National Bank Building, Chicago.

FIELD ELECTRIC BUS COMPANY.—The building of Field electric buses operated with Edison storage batteries will be conducted by the Field Electric Bus Company, of which Mr. C. J. Field is president. This company has opened general offices at 30 Church Street, New York, and has at its service the manufacturing facilities of the Toledo works of the Ohio Electric Car Company.

KIRKPATRICK, CULLEY, McCORKLE & BAYLIS, have opened offices in the Farley Building, Birmingham, Ala., to continue engineering practice in the Southern States, making a specialty of consultation, reports, appraisals, plans, specifications and supervising construction for hydro-electric power developments and municipal improvements. The firm consists of Messrs. Walter G. Kirkpatrick, Massena L. Culley, John E. McCorkle, Jr., and John R. Baylis.

J. F. BUCHANAN SUPPLY COMPANY.—A retail store where a full line of electrical appliances for the household will be demonstrated will be opened on Chestnut Street, Philadelphia, within a few weeks, by the J. F. Buchanan Supply Company, one of the pioneer contracting and jobbing houses in that city. The store will be fitted with high-grade fixtures, will cater exclusively to the retail trade, and will doubtless be a model for many similar appliance stores throughout the country.

ELECTRIC STORAGE BATTERY COMPANY.—The Electric Storage Battery Company, of Philadelphia, has recently closed a contract with the New York Edison Company for the addition of four "Exide" batteries to the forty-five batteries this company now has in service. This contract is said to be the largest ever made for storage batteries in central-station service, the four batteries having an emergency rating of 138,620 amp. One of these batteries will be the largest central-station battery in the world, having an emergency rating of 48,140 amp. All of the forty-nine batteries for the New York Edison system have been built and installed by the Electric Storage Battery Company. They have a one-hour rating of 158,330 amp.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 30, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,024,495. ELECTRIC-LIGHTING SYSTEM; E. and N. R. Booth, Halifax, England. App. filed Oct. 26, 1910. Series incandescent lamp system.

1,024,498. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed Feb. 3, 1902. Two-wire common battery central exchange system.

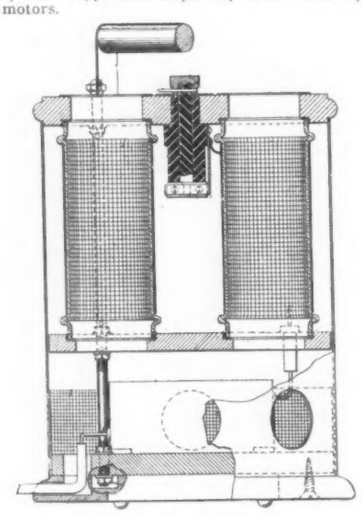
1,024,533. OZONIZER; H. R. Stuart and W. H. Thompson, Wilkinsburg, Pa. App. filed May 9, 1911. Adjustable portable instrument with a condenser.

1,024,538. MAGNETIC SEPARATOR; J. Weatherby, Jr., New Cumberland, Pa. App. filed Sept 16, 1910. For comminuted ores.

1,024,539. MAGNETIC ORE SEPARATOR; J. Weatherby, New Cumberland, Pa. App. filed Aug. 25, 1911. Concentric pole pieces and a conical armature.

1,024,555. MANUFACTURE OF VACUUM LIGHTNING ARRESTERS; F. S. Chapman, Toledo, Ohio. App. filed Nov. 16, 1910. Process of limiting the degree of exhaustion.

1,024,557. SYSTEM OF ELECTRIC-MOTOR CONTROL; F. Conrad, Swissvale, Pa. App. filed Sept. 19, 1910. Over-speed device for railway motors.



1,024,533.—Ozonizer.

1,024,565. CONSTANT-TEMPERATURE BATH; T. B. Freas, Chicago, Ill. App. filed March 22, 1911. Two switches subject to inside and outside temperature respectively.

1,024,572. MAGNETIZABLE WEDGE FOR DYNAMO-ELECTRIC MACHINES; R. E. Hellmund, Pittsburgh, Pa. App. filed Aug. 2, 1909. For holding coils in the core slots.

1,024,577. PRIMARY BATTERY; C. E. Hite, Burlington, N. J. App. filed July 27, 1907. The carbon electrode acts as a porous diaphragm.

1,024,587. ELECTRIC-CIRCUIT-CONTROLLING APPARATUS; T. L. Lee, Jr., Westfield, N. J. App. filed June 29, 1910. Support for a wire-gauze contact.

1,024,588. ELECTRIC-CIRCUIT-CONTROLLING APPARATUS; T. L. Lee, Jr., Westfield, N. J. App. filed Feb. 12, 1910. Yielding wire-gauze contact.

1,024,590. SELECTIVE SIGNALING MEANS; J. McFell, Chicago, Ill. App. filed July 27, 1910. Party-line selector.

1,024,597. ELECTROLYTIC CELL; O. H. and A. F. Pieper, Rochester, N. Y. App. filed Oct. 9, 1908. Alternating-current rectifier.

1,024,601. TERMINAL-ATTACHMENT-ENGAGING DEVICE; J. E. Schaefer, Jr., Detroit, Mich. App. filed Aug. 18, 1910. For spark plugs.

1,024,622. MEANS FOR EXPLODING CHARGES; C. I. Dodson, Pittsburg, Kan. App. filed Sept. 26, 1910. For blasting in mines, etc.

1,024,629. METHOD OF TREATING IRON ORES; B. F. Halvorsen, Christiania, Norway. App. filed March 25, 1909. Electric-furnace treatment to expel sulphur.

1,024,631. CONTROL SYSTEM FOR ELECTRIC MOTORS; H. D. James, Pittsburgh, Pa. App. filed Sept. 26, 1910. For traveling cranes.

1,024,635. REVERSIBLE INDUCTION MOTOR; F. R. Kunkel, Edgewood Park, Pa. App. filed July 6, 1908. Single-phase.

1,024,657. ELECTRIC FURNACE; E. Stassano, Turin, Italy. App. filed Aug. 7. 1911. Oscillating chamber.

1,024,709. ELECTRIC AUTOMOBILE CLOCK; W. H. Thompson, Memphis, Tenn. App. filed June 6, 1911. Electrically wound, but spring-operated.

1,024,719. ELECTRIC CONTACT DEVICE; C. W. Coleman, Westfield, N. J. App. filed Sept. 10, 1910. Contact stop support.

1,024,769. CONTROLLER REGULATOR; C. P. Ebersole, Philadelphia, Pa. App. filed Sept. 8, 1911. Slow-starting, but quick release.

1,024,793. MEANS FOR REGULATING ELECTRIC CIRCUITS; H. Leitner, Maybury, Woking, and R. N. Lucas, Dartnell Park, Byfleet, England. App. filed Jan. 5, 1905. Railway lighting system.

1,024,807. AUTOMATIC STARTING DEVICE FOR SINGLE-PHASE INDUCTION MOTORS; P. J. Ray, Lakewood, Ohio. App. filed Jan. 25, 1912. Centrifugal cut-out.

1,024,853. MEANS FOR OPERATING SEMAPHORES; W. K. Howe, Rochester, N. Y. App. filed April 30, 1909. Electric motor-operated railway signal.

1,024,857. PROTECTIVE DEVICE; A. G. Jones, San Francisco, Cal. App. filed Oct. 10, 1911. Electrolytic cells.

1,024,896. ELECTRO-MAGNETICALLY OPERATED SWITCH; G. H. Hill, Schenectady, N. Y. App. filed Jan. 4, 1906. For alternating-current.

1,024,898. FILAMENT SUPPORT; J. W. Howell, Newark, N. J. App. filed Dec. 17, 1906. Flattened wire formed into a tube.

1,024,902. SWITCH-BOX; J. Kronberger, Coney Island, N. Y. App. filed Jan. 20, 1910. Adjustable face plate.

1,024,923. PROCESS OF DRYING CEMENT CLAMPS FOR FILAMENTS OF ELECTRIC LAMPS; H. W. Bressler, Charlottenburg, Germany. App. filed May 11, 1909. Oxidizing gas is burned in a reducing atmosphere.

1,024,931. METER CONNECTION BOX; F. C. Grady, Indianapolis, Ind. App. filed Sept. 15, 1910. Interchangeable connection.

1,024,963. ALTERNATING-CURRENT REGULATOR; T. E. Adams, Cleveland, Ohio. App. filed Jan. 19, 1906. Fixed cores and a movable armature.

1,024,970. TROLLEY WHEEL; W. M. Boyer, Johnstown, Pa. App. filed Dec. 4, 1911. Sectional wheel with yieldable rim flanges.

1,024,972. BURGLAR-ALARM ATTACHMENT; G. E. Brewster, New York, N. Y. App. filed May 17, 1911. To be inserted between a door and its frame, etc.

1,024,984. CONTROLLER FOR ELECTRIC MOTORS; J. R. Garner and M. R. H. Mueller, Aston, Birmingham, England. App. filed June 30, 1911. Magnetically operated double-pole switch; barrel type; for machine drive.

1,024,985. CONTROLLER FOR ELECTRIC MOTORS; J. R. Garner and M. R. H. Mueller, Aston, Birmingham, England. App. filed June 30, 1911. Barrel type.

1,024,998. ELECTRIC HEATING ELEMENT; J. C. C. Macdonogh, London, England. App. filed Sept. 12, 1911. Separated heating coils.

1,025,020. ELECTROMAGNET; A. Quastenberg, Erfurt, Germany. App. filed Nov. 2, 1911. Cylindrical faced.

1,025,021. HOMOPOLAR, ACYCLIC OR UNIPOLAR DYNAMO-ELECTRIC MACHINE; O. Schulz and W. H. Eyermann, Charlottenburg, Friedenau, Germany. App. filed Feb. 8, 1911. The armature conductors form the rotors of steam turbines.

1,025,047. ELECTRIC GAS-LIGHTING AND EXTINGUISHING APPARATUS; J. S. Benton, Johnstown, Pa. App. filed July 16, 1910. Electromagnet device contained in a gas chamber.

1,025,091. SAFETY DEVICE FOR PASSENGER-CARRYING CONVEYANCES PROPELLED BY ELECTRICITY; W. B. Hopkins, Denver, Col. App. filed Oct. 4, 1909. The power circuit is opened by a person on the step.

13,409 (reissue). MOISTURE-PROOF PACKING; R. V. Collins, New York, N. Y. App. filed Jan. 5, 1909. Railway ground switch.